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ECONOMY IN SUGAR PRODUCTION.

There is probably no country in the world where the raising of sugar cane and the manufacture of sugar has been so carefully studied, and so successfully conducted as in Hawaii. In such matters the sugar men here have certainly progressed as far as any of their foreign competitors. New methods and improvements are being continually sought for and adopted, and vast strides have been made in the past few years in the adoption of labor saving devices and appliances both in the field and mill, and in the application of cheaper fuel on many of the plantations especially where large pumping plants are necessary. Numerous labor saving devices are mentioned in the report of the last committee on machinery presented at the annual meeting in November, 1902, but it requires actual observation of such appliances to appreciate the advance that has been made toward more economical production of sugar; one is especially struck with the working of a modern cane unloader at the carrier, installed in some of the large mills, and operated by one man, where formerly several were required to produce the same results.

It would seem that the planters are on the road to achieving a degree of perfection in the matter of cultivation and manufacture, but is there not lacking among the planters a co-operation in the practical work, and a combination of interests which mean so much, and by virtue of which so much has been accomplished on the mainland in the large industries there? All due consideration is given to the results obtained by the various planters' associations of the different Islands, but those planters who have been worked out certain methods and obtained good results, should do more toward making such results public in order that others may profit thereby.

If all the better methods in vogue could be thoroughly discussed and given publicity, and as much as possible, so far as local conditions will permit, a uniform method of work adopted in the various departments all the planters would receive benefit thereby without in any manner injuring any other. In this connection great credit must be given to the newly formed Chemists' Association which is a step in the right direction, and it would be for the good of the whole industry that chemists and managers give their hearty co-operation to the work which this Association is attempting to accomplish. An Association of engineers along the same lines would be of immense value to the plantations as well as to its members.

In the matter of centralization or combination of capital there is an object lesson in more than one district of these Islands. Pass through a certain District in Hawaii and observe the number of mills, and yet the total tonnage of that district for the year 1902 was less than five thousand tons,—less than the crop of Kihei plantation. These mills are in operation say six months in the year; for the balance of the time there is that much idle capital, with separate organized labor for each factory. They were constructed in the days when the price of sugar was high, labor cheap and plentiful and the planters enjoyed properity. What a saving of expense there would be if these plants were under one Management,—one mill.

It is true that there are some districts where by reason of geographical features it is necessary to have a mill for each plantation, but there are other places where combinations could be effected—Maui for instance, Hamakua possibly, Hilo and portions of Kauai. Combination of interests should be the watchword, and it behooves some of the struggling plantations companies to labor with their neighbors and arrive at some definite plan whereby expenses may be reduced and profits increased.

It is realized that great difficulty would be encountered in the matter of finances connected with any such scheme, but what has been done elsewhere can surely be done here.

A more careful study of waste or by-products might result in great benefit. In this matter it would seem that we are not so far advanced as other sugar producing communities. An interesting paper was recently written by Mr. Williams of Puunene on the manufacture of sugar at Hawaiian Commercial and Sugar Co's. plantation, for a foreign organization of Engineers and republished in the International Sugar Journal, with the comments of the members of the organization. Astonishment was expressed at the enormous size of the factory and the high degree of centralization existing. But one matter which was freely criticized was the burning of molasses for fuel; it was considered a wasteful process and inquiry was made why the molasses was not used for making rum or alcohol as in the West Indies and Demerara. On some of the plantations here they use a portion of molasses as fuel mixed with begasse and on some they use it for fertilizing, but on a great number of the plantations it simply goes to waste. On a large plantation where artificial irrigation is not practiced, it was observed that several miners inches of molasses were running to waste daily during the grinding season.

The Committee on Manufacture called especial attention to this matter at the last annual meeting of the Hawaiian Sugar Planters' Association and suggested special investigation of the subject for report at next meeting.

The sugar industry is in these Islands to stay. Difficulties will be met and disasters may come, in the future as they have in the past, but the planters are equally sure to overcome them in the future as they have in the past. Adverse legislation may come to injure us, but when we stop to consider the amount of capital invested in cane and beets in the United States, and the vast scope of the industry, stretching from Maine to California, we may well believe that no radical legislation will be enacted which will destroy that industry and in so doing destroy us; it is believed by those who ought to know that the recent reciprocity treaty with Cuba, even if finally ratified, will not affect in any appreciable manner the price of sugar in the United States. In addition to this bounties have now been abolished in the beet sugar countries of Europe, which should tend to decrease the overproduction in those countries as also the large supply coming into the United States.

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EARLY RECORDS OF AN OLD PLANTATION.

Some time ago the writer had occasion to examine the minutes of the first meetings of stockholders of one of the oldest sugar plantation companies established in these Islands, and certain matters were disclosed which, to the present observer, seem very remarkable.

This plantation was started on a small basis by one of our best known and respected missionary families for the purpose of giving employment to the native Hawaiians living in that district. Many of the Hawaiians had left the district to go to the larger seaport towns, where lucrative employment could be obtained and a more pleasureable life led. The life led in the towns at that time much frequented by whalers, resulted in the moral and physical decline of the race, and it was with the laudable purpose of checking their migration by giving the Hawaiians an opportunity to earn a good livelihood in the country that the plantation was established.

While great interest was taken by the owners of the plantation in the bodily comfort of the laborer employed, it was intended also that his soul should be equally well looked after. Apparently numerous methods had been experimented with for the purpose of seeing that the laborer attended church frequently with but indifferent success, and finally at a stockholders' meeting questions were considered and replies given as follows:

1. Shall we insert in the contracts with the laborers a clause compelling them to attend church once every Sunday on pain of dismissal from service?

Answer: No.

2. Shall we make a rule of the plantation that the people shall attend church once on Sunday and enforce the same by fine or other punishment.

Answer: No.

3. Shall we refuse to allow those whose homes are in the District to go to the same on Saturday afternoons to spend Sunday with their friends or families, and shall we assume the responsibility of their not attending church while they are thus absent from the plantation?

Answer: No.

4. Shall we require the manager to do more to enforce attendance at church than to use persuasive measures thereto, and setting them an example of attending himself?

Answer: No.

5. Shall a weekday prayer meeting during labor hours be allowed among the people?

Answer: No.

6. Shall such weekday meeting be held whenever the manager can spare the people from work on notifying the Reverend Mr. B— of the occasion?

Answer: Yes; and at such meeting the manager shall compel attendance of all the laborers, excepting the Roman Catholics, on pain of fine or dismissal.

7. Shall religious meetings be held on the plantation after working hours?

Answer: Yes, as often as it may please either the Reverend Mr. B—— or themselves, but no punishment shall be inflicted for non-attendance.

8. Shall the church members on the plantation be allowed to attend, during working hours, the quarterly or business meetings of the church when such meetings are held by the Reverend Mr. B. —

Answer: Yes.

9. Shall we censure the manager for forbidding the people during working hours, or at any other time, to visit the Reverend Mr. B—— and gossiping over the affairs of their fellow-laborers?

Answer: No; but whenever the people wish to go to the Reverend Mr. B—— with their own grievances or pilikias after working hours, they shall not be hindered.

The spirit of the times has changed and any manager who would be so rash as to knock off work for a midweek prayer-service or force his employes to attend church, would soon hear from his directors.

This old plantation is now one of the best equipped in the the Islands, and it is a matter of comment that, with modern methods, it does not pay one-tenth the amount of dividends that it did in the early days.

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VALUE OF FRESHET WATERS.

By Geo. T. Wagner.

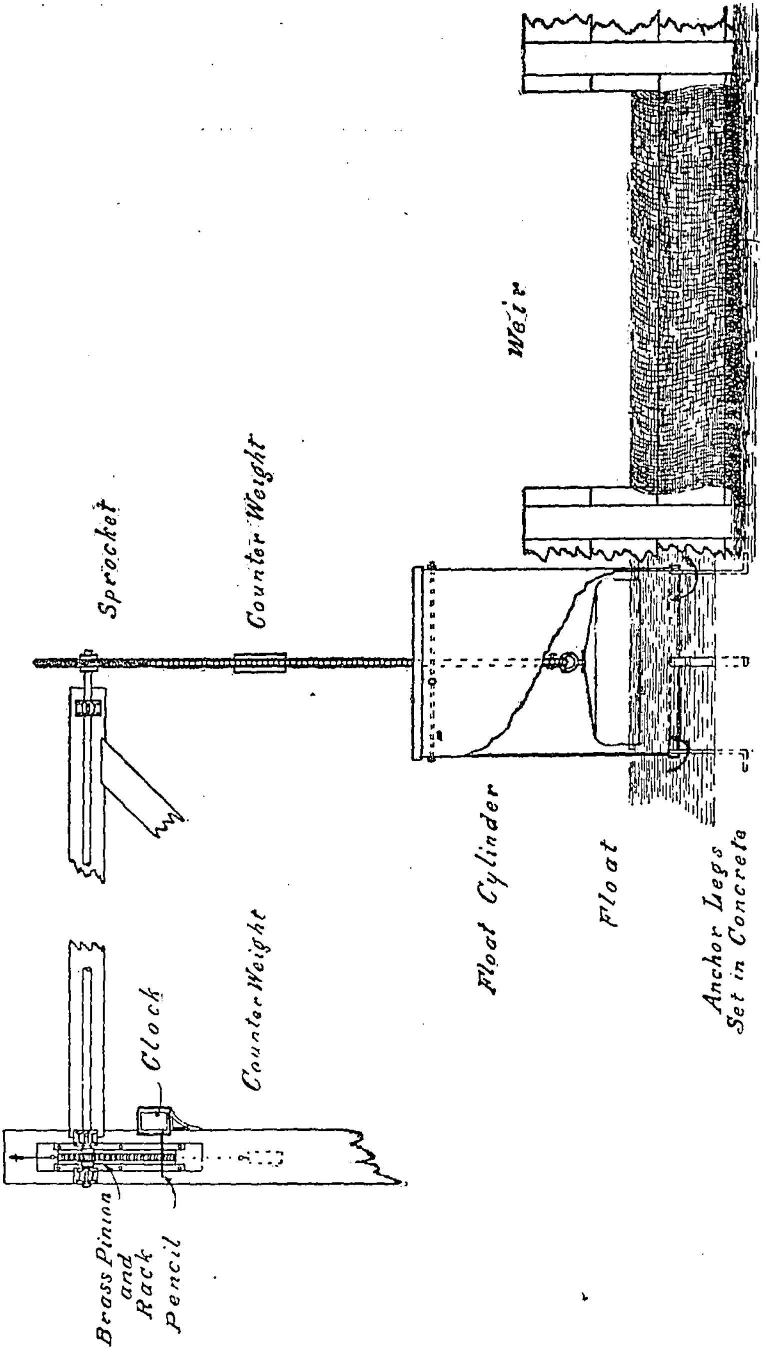
The developement of the water supply furnished by the mountain streams of these Islands has of late received considerable attention from the larger irrigating plantations in their efforts to decrease operating expenses and to expand their territory. Adverse criticism is often expressed at the enormous expense to which some of the new plantations are going to develop their mountain streams. The object in presenting this paper is to show that natural sources of water supply that can be developed at the 400 or 500 foot elevation have a considerable value and that it is simply a matter of figures to determine the justifiable outlay in any given case.

Those streams that flow the year around are of course receiving attention first, because their value is more readily determined and thoroughly understood. It is when we come to the "flashy" streams, sending occasional torrents to the sea, that we find the management of a plantation skeptical, and insisting upon the most complete evidence of the benefits to be derived when extensive improvements of this kind are contemplated.

On the Honolulu Plantation investigations have been carried on for the past 18 months for the purpose of determining the value of three such "flashy" streams. A rain gauge, a wier and an automatic recording instrument were set at the 650 foot elevation in each stream.

The recording instrument is the only one of these that requires explanation. (See sketch) The float is attached to one end of a link chain and at the other end is a counterweight about 2 lbs. lighter than the float. This chain passes over a sprocket wheel and as the float raises or lowers with the water of the stream the sprocket wheel is revolved. The float is protected from the current and debris in the stream by a guard as shown, and the water must pass under this guard. The motion of the sprocket wheel is transferred to a pinion by the small shaft. This pinion moves a rack and also reduces the motion to any desired fraction of the original change in the stream —in our case 1-6. The rack, which moves vertically, carries a pencil that traces its motion on a paper clamped around the clock cylinder. This clock makes one revolution in 8 days. The paper is so ruled that each horizontal line represents an

AUTOMATIC WEIR RECORDER



increased rate of flow over the wier of 1,000,000 gallons per 24 hours; each vertical line represents 2 hours of time—the float having been so adjusted that when there is no flow over the wier the pencil records on the zero line. In practice these papers are changed each 6th day so that the record will be continuous, even though a storm should delay the observer a day or even two days. (See sample record.)

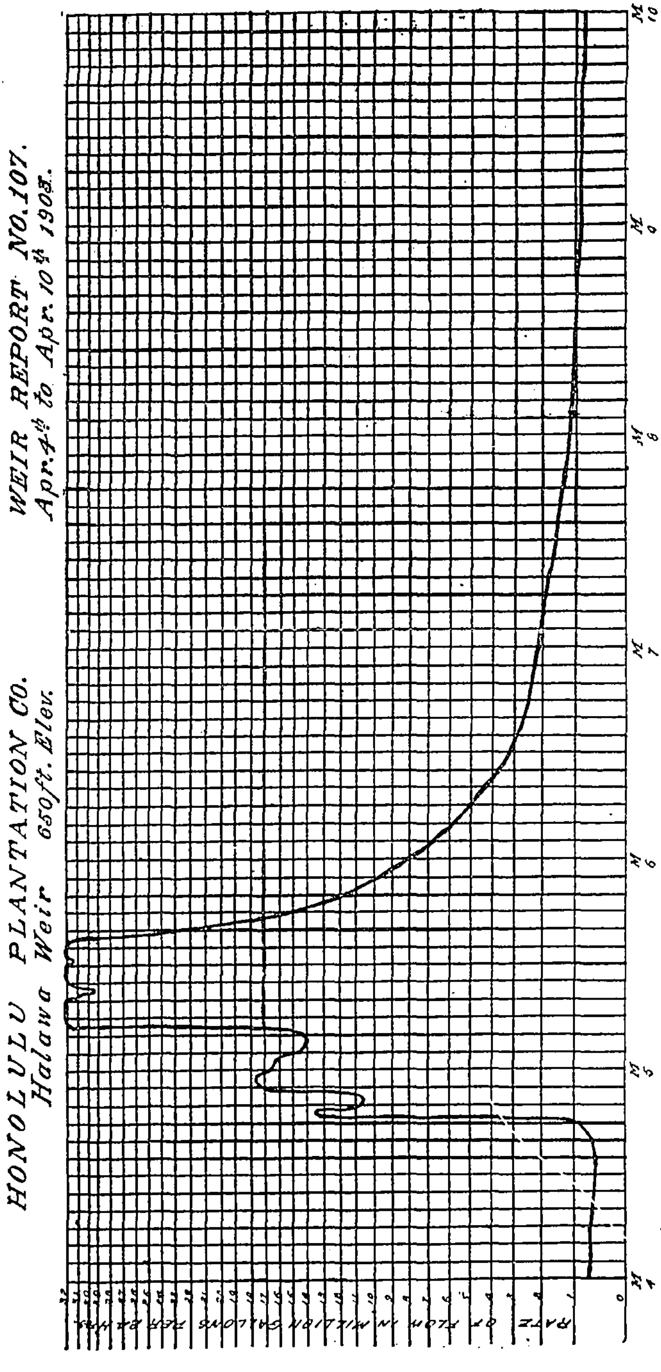
This instrument can be made for a wide difference in elevation of stream; it can be placed out of all danger and is very simple of construction. This one was all made on the plantation, except the clock, and the cost was insignificant.

These records give us accurate data from which to calculate the quantity of water flowing in the stream. I give below the results of 18 months observation in Halawa Valley. (Note: first 9 months are calculated by the formula—(rainfall in inches—4) x 6 = run off.)

Year.	Month.	Rainfall.	Run-off in million gallons.
1901	December	21.68	106.1
1902	January	5.35	0.0
"	February	5.14	0.0
"	March	57.10	318.6
"	April	14.54	63.2
"	May	22.93	113.6
"	June	8.31	25.8
"	July	15.16	67.0
"	August	10.68	40.1
"	September	12.02	47.0
"	October	14.36	68.4
"	November	23.71	113.0
"	December	29.37	158.0
1903	January	11.65	54.1
"	February	11.05	38.9
"	March	4.92	0.0
"	April	18.91	84.0
"	May	6.76	11.6
			1309.4
or for 12 months,			873.0

Deduct 15% for loss on ditches, reservoirs and by evaporation that takes place before water is put on land, 742.0 net.

We now want to know the value of this water when delivered on the cane land at say the 450 foot elevation, or in other words what will it cost to pump 742,000,000 gallons to the 450 foot elevation.


HONOLULU PLANTATION CO.
Halawa Weir 650ft. Elev.
WEIR REPORT NO.107.
Apr.4th to Apr.10th 1903.
RATE OF FLOW IN MILLION GALLONS PER DAY

From the most reliable sources available I find the average cost of lifting 1,000,000 gallons of water one foot, with coal as fuel, to be as follows:

Operating expenses,	$ 0.081
Interest, 6%	0.014
Depreciation, 3%	0.007
	$ 0.102

Now that fuel oil has been introduced, the average results as derived from short trials at various pumping stations indicate that the cost now is as follows:

Operating expenses,	$ 0.053
Interest, 6%	0.014
Depreciation, 3%	0.007
	$ 0.074

This makes 1,000,000 gallons at the 450 foot elevation worth $33.30, and we have for the supply furnished by the stream $33.30x742=$24,708.60 per year. For the purpose of illustration let us assume that a ditch of 50,000,000 gallons capacity per 24 hours and the necessary reservoir capacity can be constructed for $75,000. Also that the leases on cane lands expire in 30 years. We then have to deduct yearly from the above, as follows:

Interest, 6% on $75,000	$4,500.00	
Operating expenses and repairs,	1,200.00	
Sinking Fund, 4% interest,	1,285.70	$ 6,985.78
and we have a net gain of,		$ 17,722.82

In studying the rainfall of Halawa Stream as given above we see that to obtain a sufficient and uniform supply from such freshet streams we must have larger storage reservoirs to tide over the dry spells and that the water must be stored at times for 2 or 3 months. Generally it will be found that the reservoir sites obtainable are at fault or that the loss in seepage is so great that water could not be stored for the required time, and if a plantation depended upon such a source it would not have that absolute assurance of sufficient water supply, which is the main advantage that an irrigated plantation has over one depending on rainfall.

However even under the unfavorable conditions assumed, when such freshet waters are developed in connection with pumps and considered as a part of one complete system supplying a large area the average cost during a year of putting water on lands up to the 450 foot elevation will be well within the limits of economy. In cases where large and safe storage reservoirs are available and the rainfall more regularly distributed this source of supply could be depended on entirely, and of course the results would be still more satisfactory. In such cases the limit of expansion depends upon the elevation at which the water can be developed, the elevation at which cane can be successfully raised, available lands, etc.

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THE PROFIT OF HEAVY MACERATION IN A CANE SUGAR-FACTORY.

The following calculations are based on figures obtained at Oahu Sugar Plantation and therefore refer more particularly to the conditions prevailing at that place.

The first three months of the season 1903 gave about the following results with our mill:

92.97% Extraction on total sucrose in cane.
24.00% Begasse on 100 cane.
4.25% Sucrose in Begasse.
45.20% Moisture in Begasse.
48.75% Fibre in Begasse.
1.80% Solubles in Begasse.
14.50% Sucrose in cane.
1.02% Sucrose lost in begasse on 100 cane.
13.48% Sucrose extracted on 100 cane.
11.70% Fibre in cane.
14.00% Dilution on normal juice=11.27% on cane.

As the begasse has 4.25% sucrose, 1.80% solubles and 45.20% moisture, it contains 4.25+1.80+45.20=51.25% juice or residual juice.

The juice extracted by the last mill has the following composition 7.0 Brix—5.60 sucrose, 80 Purity.

As the begasse has 4.25% sucrose dissolved in 51.25% residual juice, this juice will contain

$$\frac{4.25 \times 100}{51.25} = 8.29\% \text{ sucrose.}$$

Last mill juice 5.60 sucrose; residual juice 8.29% mixing factor

$$\frac{5.60 \times 100}{8.29} = 66.7\%$$

which means that 66.7% of the amount of water used for maceration has acutally been mixed with the juice in the cane.

100 cane give 24.00 begasse and as this contains 51.25% residual juice: 12.3% residual juice is left in begasse on 100 cane.

Suppose we add another 3-roller-mill to our plant and grind our begasse through it after macerating with 17.5% of water or more (equal to 14% on cane) making the total dilution 14+17.5—31.5% on normal juice.

To be on the safe side, I take the mixing factor 55 instead of 66.7. The begasse produced will have the same moisture as in the former case, the additional mill pressing all the water out again that was used. As there will be about 2.5% sucrose left in the begasse the percentage of residual juice will be 2.5+1.50+45.20=49.20 in 23% begasse in cane making

$$\frac{23 \times 49.2}{100} = 11.3\%$$ residual juice on 100 cane.

14% dilution with 55 as a mixing factor makes only 7.7% of water actually mixing with the 12.3% of residual juice in the begasse to be ground.

We found for sucrose in residual juice 8.29%. After macerating the juice will contain $\frac{8.29 \times 12.3}{12.3+7.7} = 5.10\%$ sucrose. And as the begasse will have 49.2% of residual juice, the sucrose in begasse will be: $\frac{5.10 \times 49.2}{100} = 2.51\%$.

Begasse 23% in cane; sucrose 14.50% in cane. Sucrose lost in begasse on 100 cane 0.58%. Extraction on total sucrose 96.00.

Begasse entering last mill contains 1.02% sucr. on 100 cane.
Begasse leaving last mill contains 0.58% sucr. on 100 cane.

Saved........ ....0.44%

On a crop of 225,000 tons of cane giving 30,000 tons of sugar, 990 tons of sugar more will be extracted in juice. The purity of this juice will go down to 75%. The amount of this juice will be 14% on cane=31,500 tons of juice. The sucrose in this juice will be $\frac{0.44 \times 100}{14} = 3.14\%$ and its composition 4.2 Brix 3.14 sucrose 75.0 purity. Available sugar: S—0.4 (B—S)=2.73%; 31500x2.73=860 tons of available sugar out of the 990 tons extracted will be made. The ton of sugar at $50.00 makes $43,000 value.

The expenses are figured as follows:

31500 tons of juice of 4.2° Brix made $\frac{31500 \times 4.2}{60} = 2205$ tons of syrup of 60° Brix; 31500—2205—29295 tons of water to be evaporated in a quadruple effect, requiring 1 ton of steam for every 3 tons of water to be again on the safe side=10000 tons of steam.

2205 tons of syrup of 60° Brix to be boiled to massecuite of 95° give 1400 tons of massecuite leaving 2205—1400=805 tons of water to be evaporated in the vacuum pan requiring 1.2 tons of steam per ton of water: 970 tons of steam. Take 5% loss in steampiping and for power used in extra mill machinery makes 11520 tons of steam total.

As one ton of coal generates 7.5 tons of steam 1536 tons of coal are required to produce the necessary amount of steam; the ton of coal at $8.00 makes a $12,288 coal bill. Since we use fuel oil instead of coal we save 30% expenses and the $12,288.00 can be safely reduced to $8,600.00 leaving a margin of $34,400 in one season.

The additional 3-roller-mill with gearings and engine costs $30,000.00 put up at the factory.

Take 10% amortisation, 5% interest and 5% for reparations makes $9,000.00.

The profit per season of 30000 tons of sugar will be $25,-400.00.

P. A. G. MESSCHAERT.

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THE LIMIT OF ECONOMY IN MACERATION.

By Ernest E. Hartmann.

While the opinion, more or less frequently met with until recently, that Maceration is a fad, which should be left alone because "it spoils the juice," has probably but few adherents left, there is a great difference in the views held in regard to the extent to which dilution may to advantage, be carried and there is also a tendency to go to the other extreme. The cause for this variety of opinions lies in the fact that, what has been of great benefit in one factory has proved a failure somewhere else; the process may not have been suitable, or prejudice may have proved too strong.

The practice of regulating the maceration according to the amount of bagasse available for fuel has become almost universal in these islands. The practice is a safe one, as there is, broadly speaking, none of the cane produced here of such low purity that the amount of water used for Maceration would have to be limited for fear that the juice extracted would contain so much impurities as to cause an actual loss of sugar. The question then remains: To what extent is it profitable to supplement the bagasse with coal? The chief factors, which determine this point, are the purity of the juice and the percentage of sugar in the cane. In the first place, let us see what purity the juice will have, which we are to extract from the last 7% left in the bagasse. It is evident that this purity will vary with the purity of the cane-juice. Owing to the uneven distribution of the Sucrose in the cane, this variation is, however, not constant, and different varieties of cane in different stages of maturity give widely different results, but averages obtained from a large number of data collected at different factories, are sufficiently representative to be of value in calculating the limit, to which the Sucrose may be profitably extracted by means of water.

In table I the purities of the various juices as they are successively expressed are given in their relation to the purity of the first mill juice. The latter taken at 95, 90 and 85. The extraction by the individual mills is assumed to be the same in all three cases.

Table I.

Extraction Per-cent Sucrose in cane.	Purity of Juice. Extracted.	Left in Bag.	Purity of Juice. Extracted.	Left in Bag.	Purity of Jnice Extracted.	Left in Bag.
The first 80	95	85	90	77	85	70
" following .10	90	79	83	70	76	64
" " ... 3	88	75	79	88	71	61
" " 1	86	73	77	66	68	60
" " 1	82	71	74	64	65	59
" " 1	77	70	70	63	61	58

By the aid of this table and the formula:

$$\text{Obtainable Sugar} = \text{Sucrose} - \frac{\text{Brix}-\text{Sucrose}}{2}$$

we find the percentage of sugar, we would actually obtain for every 1% of sucrose extracted.

Table II.

For 1% Sucrose extracted between:	Purity 95 Sucr. % Cane	10	12	14	16
93 and 94%	obtainable sugar % cane	.092	.110	.128	.147
94 " 95%	"	.089	.106	.124	.142
95 " 96%	"	.085	.102	.119	.136
	Purity 90 Sucr. % Cane	10	12	14	16
93 and 94%	obtainable sugar % cane	.085	.102	.119	.136
94 " 95%	"	.082	.099	.115	.132
95 " 96%	"	.078	.094	.110	.126
	Purity 85 Sucr. % Cane	10	12	14	16
93 and 94%	obtainable sugar % cane	.076	.092	.107	.122
94 " 95%	"	.073	.087	.102	.117
95 " 96%	"	.068	.082	.095	.108

The next thing is to ascertain how much water is required for each additional 1% of sucrose extracted. I attempted at first to obtain these data from the relation between dilution and extraction, as found in the daily reports of a number of factories. The resulting average figures were, however, of no value for my purpose, and, as there are so many factors besides dilution, which influence the extraction, a satisfactory comparison could hardly be expected. There is the speed and setting of the mill, the temperature of the maceration-water, the duration of its contact with the bagasse, the proportion and the structure of the insoluble matter in the cane, the thickness and the regularity of the feed and the mode and the regularity of the application of the maceration-water. All these are factors, which to a greater or lesser extent affect the exhaustion of the bagasse. I had, therefore, to have resort to calculation for the purpose of establishing the quantity of water, which would have to be used for maceration for each one per cent. of sucrose extracted above a certain limit. The formula: Diffusion-water =

$$\frac{(\text{lbs. Sucr. in Bag. A x Juice \% Bag. B}) - (\text{Sucr. \% Bag. B x lbs. Juice in Bag. A})}{\text{Sucr. \% Bag. B.}}$$

gives us the quantity of water, which would, (complete diffusion with the juice in the bagasse assumed), bring the percentage of sucrose in bagasse A to that in bagasse B. A and B represent either Bag. I and Bag. II, or Bag. II and Bag. III.

Table III will show this quantity for 1000 lbs. of cane containing 14% of sucrose and yielding a first mill juice of 90 purity. The percentage of moisture in the bagasse is for the sake of simplicity assumed to be the same throughout.

93	.98	236	4.13	50.8		
94	.84	234	3.60	51.3	15.8	15.8
95	.70	232	3.02	51.8	39.5	23.7
96	.56	230	2.44	52.4	74.0	34.5
97	.42	228	1.80	53.2	137.2	63.2

The above quantities of water would in reality not accomplish these results, as the diffusion of the maceration-water with the juice in the bagasse is by no means complete. The Quotient of diffusion depends upon the percentage of dilution, the temperature of the maceration-water and the condition of the bagasse. The average quotient for simple maceration with say 20% hot water is about 50, for higher dilution less.

For the purpose of these calculations I assume this quotient to be 45, 43, 40 and 36 respectively—a low estimate—for single, and with an increase of say 60%, or 72, 69, 64 and 58 respectively for double maceration. The quantity of water required would therefore be:

Table IV.

Diffusion Water, lbs.	Simple Maceration Quo. of diff.	lbs. Water	Double Maceration* Quo of diff.	lbs. Water
15.8	45	35.1	72	21.9
23.7	43	55.1	69	34.4
34.5	40	86.2	64	53.9
63.2	36	175.6	58	109.0

From Tables II and IV follows—

Table V.

93—94	35.1	21.9	1.19	2.75	3.27
94—95	55.1	34.4	1.15	"	3.15
95—96	86.2	53.9	1.10	"	3.02
96—97	175.6	109.0	1.04	"	2.86

I think this sugar may well be estimated at 2¾¢ per lb. as for the purposes of these calculations the cost of manufacture (other than that of evaporation in multiple effects), may be neglected. The running expenses under ordinary conditions remain about the same whether 93 or 96% of the sucrose be taken out of the cane. The extra fuel consumption for pumping (juice pump, circulating pumps), amounting to less than one-fiftieth of that required for evaporation, may also be neglected.

Eight lbs. of steam per ton of coal is a conservative estimate. Let us assume that 1 lb. of this be consumed in heating and handling the additional thin juice, an ample allowance. As one lb. of steam of 212° F. evaporates in a quadruple effect between 3 and 4 times its weight of water, the remaining seven lbs. of steam would, taking 3¼ as coefficient, evaporate 7x3¼=22¾ lbs. water.

Table VI.

Comparison between cost of Coal and value of product. Based on 1000 lbs. cane.

Increase in Extraction.	Gross Gain	Simple Maceration. Lbs. Water Evaporated.	Lbs. Coal Requ'd.	Cost of Coal @ ½ Cent.	Net. Gain. Cent.	Loss. Cent.	Double Maceration. lbs. Water Evaporated.	Lbs. Coal Requ'd.	Cost of Coal @ ½ Cent.	Net. Gain. Cent.	Loss. Cent.
93—94	3 27	35.1	1.54	.77	2.50	.....	21.9	.96	.48	2 79	.....
94—95	3.15	55.1	2.42	1.21	1.94	.....	34.4	1.51	76	2.39	.....
95—96	3 02	86.2	3 79	1.90	1.12	.....	53.9	2.33	1 17	1.85	.....
96—97	2 86	175.6	7.72	3.86	.....	1.00	109.0	4.79	2.40	.46	..

* This term is used to designate the practice of utilizing the juice from the third mill for the maceration of the bagane issuing from the first mill.

This applies, as will be remembered, to a cane of 14% sucrose and 90 purity; it shows that with double maceration sufficient water could profitably be evaporated to obtain an extraction of 97%, while with simple maceration 96% should not be exceeded.

For the purpose of a comparison, I will substitute in the above tables the values of a cane containing only 10% of sucrose and a juice of 85 purity.

Table VI b.

Increase in Extraction.	Gross Gain	Simple Maceration. Lbs. Water Evaporated.	Simple Maceration. Lbs. Coal Requir'd	Simple Maceration. Cost of Coal @ ½ Cent.	Net. Gain. Cent.	Net. Loss. Cent.	Double Maceration. Lbs. Water Evaporated.	Double Maceration. Lbs. Coal Requir'd	Double Maceration. Cost of Coal @ ½ Cent.	Net. Gain. Cent.	Net. Loss. Cent.
93—94	2.09	37 1	1.63	.81	1.28	......	23.2	1.02	.51	1.58	..
94—95	2.01	58.6	2.58	1.29	.72	......	36.6	1.61	81	'.20	....
95—96	1.87	95.2	4.19	2.10	...	33	59.5	2.62	1.31	.56	.....
96—97	1 65	183.9	8.08	4.04	...	2 39	114.9	5.05	2.53	......	.83

It will be seen, that here the limit is fully 1% lower.

The consumption of fuel is more or less influenced by other factors, such as the deterioration of the value of the bagasse as fuel owing to the additional exhaustion and a slight increase in the percentage of moisture, also the lowering of the purity of the mixed juices, and a consequent increase in the time required for boiling, factors which would tend to give slightly higher values for the quantity of coal required, but which it would be difficult to express in figures. Ample allowance has however been made in the estimate of the evaporation per lb. of coal to cover such points.

The values given above apply to average conditions as they are to be found in the modern mills of these islands. The quotients of diffusion have intentionally been chosen low; the amounts of water actually required would in most cases be found to be less than stated in the tables. Where it is desired to ascertain the limit for any particular case, this quotient should be determined under average running conditions. It is expressed by:

$$\frac{\text{Diffusion-water} \times 100}{\text{Maceration-water}} = \text{quotient of diffusion.}$$

The formula for the calculation of the former is given between Tables II and III. For double maceration it is necessary to determine this quotient separately for the diffusion of the water with the juice in the bagasse from the 2nd mill, and that of the 3rd mill juice with the juice in the bagasse from the 1st mill. The two added, represent the total efficiency of the maceration water.

PUUNENE, MAUI, MAY 29TH, 1903.

Editor. "Planters' Monthly."

DOES IT PAY TO MAKE HIGH POLARIZING SUGAR

It is well known that our raw sugar is paid for on a basis of 96° polarization, which = 96 lbs. of pure sugar in 100 lbs. of the product. If the market price is 3 1-2 cents per lb., and our sugar polarizes 96°, we get $3.50 per cental; it will readily be seen that we have sold with the 96 lbs. of pure sugar, 4 lbs. of impurities (which consist principally of molasses), at 3 1-2 cent per lb. This is a good price for molasses of any description, and makes it well worth paying freight on.

On the other hand, in the San Francisco market for every degree rise over 96°, we are paid 1-32 of a cent more per lb., which means, if our sugar polarizes 97°, that we get 3 4-32 cents, for the additional lb. contained in one hundred. Therefore it is obvious that at the before mentioned price the planter would actually lose money in San Francisco on the sale of sugar over 96°. The New York market advances the price 1-16 of a cent per lb. for every degree over 96°, which makes it apparently worth while to turn out as high a grade sugar as possible for that port, still it is an open question whether it would not be more profitable to make a uniform grade of sugar polarizing 96°; it would result in a much greater first recovery of sugar, and a consequently greater final recovery, and it would also make a reduction in the cost and loss of manufacture, and an increase in the capacity of the boiling house.

WM. SEARBY.

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THE PROTECTION OF CANE-CUTTINGS DURING TRANSPORT.

By Albert Howard, M. A., F. L. S.,

Late Mycologist to the Imperial Department of Agriculture for the West Indies.

Since the discovery of the fact that the sugar-cane bears fertile seed, a considerable amount of attention has been devoted to the raising and testing of new seedling canes in Java, the West Indies, and elsewhere. In consequence, a large number of new canes have found their way into cultivation in these localities, some of which appear to be more disease-resisting than the older varieties. It would appear to be desirable for the Experiment Stations of each sugar-growing country to test, not only its own seedlings, but also those produced in other parts of the world. Further, in the breeding of new varieties such desirable canes as the Cheribon of Java, and the wild varieties of India, would be of considerable value, judging from the latest Java results. Possibly, some of the imported canes would give better results than those produced locally. At any rate, the matter would seem worthy of careful trial.

Unfortunately, however, two difficulties have to be reckoned with in attempting to carry out such tests. In the first place, the cane-growing localities are widely separated, and the only practicable means of sending canes from, say, Java to the West Indies would appear to involve the use of a Wardian case and arrangements being made for the watering of the young canes several times on the journey. Such a method involves great expense, and besides, would only be practicable during the summer. In the second place, there would be a danger of introducing new insect and fungoid pests along with the canes. A method, therefore, at once safe, cheap, and expeditious, would seem to be desirable. The preliminary experiments on the subject, referred to in the present paper, are put forward in the hope that they may be of use in the solution of the question.

While engaged in a study of the diseases of the sugar cane in the West Indies during the past three years, I had occasion to pay some attention to the fungi which destroy cane cuttings soon after they are planted and the methods of prevention applicable thereto. It was found that if the cuttings were dipped in Bordeaux mixture and then tarred at the cut ends, that the ravages of West's "pine apple" disease fungus (*Thielaviopsis ethaceticus*), are greatly lessened.* During these experiments some cane cuttings were left in Bordeaux mixture for a week. When planted, they all grew readily and appeared to have suffered little or no harm from their long immersion in this fungicide.

In order to determine what happens if cuttings are kept in Bordeaux mixture for longer periods, and whether it would be practicable to send cuttings long distances while immersed therein, the following experiment was carried out: One hundred and sixty healthy cuttings, each with three buds, were selected, placed in the fungicide for twelve hours and then allowed to dry. Half of these were then tarred at the cut ends. The cuttings were then made up into four bundles of

*The experiments referred to here were published in the West Indian Bulletin, Vol. III., No. 1, 1902, and are noticed in the International Sugar Journal of July, 1902. (Vol. IV., p. 363).

forty each (twenty of each set being tarred at the ends), and then placed in a barrel of Bordeaux mixture. At the end of the second, fourth, sixth, and eighth week one set of cuttings was taken out, washed for twelve hours in water and then planted. The results are given in the following table:—

Length of time in Bordeaux Mixture.	Tarred.		Untarred.	
	No. of cuttings which grew.	No. of buds which developed.	No. of cuttings which grew.	No. of buds which developed.
14 days ..	19	25	20	27
28 " ..	13	20	15	22
42 " ..	4	4	5	9
56 " ..	2	4	5	8

The rapid falling off in development which took place, when the cuttings had been immersed for more than a month, was apparently due to the fact that the fungicide had penetrated the tissues of the cutting to a great extent and destroyed the buds. That even seven of the forty cuttings which had been in the mixture for eight weeks should have grown is, to say the least, surprising. The result of the experiment indicates that an immersion of more than twenty-eight days is distinctly harmful, while a shorter period does not seem to be attended with much loss of growing power.

It now appeared desirable to find whether cuttings which had been placed in the fungicide for a short time (24 to 48 hours) could be kept in pulverised charcoal, to which a small quantity of powdered copper carbonate had been added to check the development of fungi. As time did not permit of this experiment being tried in the West Indies, a preliminary test, on a small scale, was made at the Botanical Gardens at Cambridge. Ten cuttings from a mature cane, growing in the Lily House, were placed in Bordeaux mixture for 24 hours, and then, after drying, in powdered charcoal, to which had been added a small quantity of copper carbonate. The box containing the cuttings was placed in the tropical pit at the gardens for 63 days, after which the pieces of cane were planted. Although the cuttings had dried very considerably during their stay in the charcoal, four out of the ten developed. It would seem that if the charcoal had been slightly moistened, so as to prevent this drying up, a better result might have been obtained. Perhaps treatment of the charcoal with Bordeaux mixture and then partial drying would have been better. If the charcoal were too moist, growth would take place; if too dry, the cuttings would shrivel. The exact amount of moisture necessary to prevent excessive drying without leading to root development would have to be determined by experiment.

It would appear therefore that this method deserves a trial. If found to be successful, cuttings could be sent from place to place through the post, and the danger of introducing new pests would be reduced to a minimum.

These experiments are put forward, incomplete and inadequate as they are, in the hope that further work on the subject may be undertaken by others, and that a method may ultimately be found by which plant introduction in the case of the sugar-cane may be rendered easier, cheaper, and safer than seems to be the case at present.—International Sugar Journal.

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THE CULTURE OF SUGAR CANE AND ITS MANUFACTURE.

(Address by Dr. W. C. Stubbs, director of Louisiana Experiment Stations to Interstate Cane Growers' Convention, held at Macon Georgia, May 6, 7 and 8, 1903.)

I am here to-day responsive to your invitation to address you upon a subject, old to us in Louisiana, yet new and full of interest to you—to speak to you of an industry fraught with incalculable wealth to the entire South, if properly prosecuted.

This convention is another manifestation of the awakening of this land to the magnificent destiny which awaits it, and is another realization of the dreams of our youth and the hopes of our matured manhood.

Permit the remark in the beginning, that the subject of the culture of the sugar cane and its successful manufacture into syrup or sugar, is a long and exhaustive one—bewildering to the novice, intricate to the mechanic, alluring to the chemist, attractive to the farmer, and extremely profound and taxing to the one entrusted to the management of a large sugar estate.

Sugar cane is a gigantic grass. Its stalks, composed of nodes and internodes, or joints, are surrounded with alternate leaves, which on maturity fall off, leaving the clean canes for the mill. Wherever sufficient warmth and rainfall (or irrigation) prevail, there can cane be cultivated. It is now grown from thirty-seven degrees north latitude to thirty-seven degrees south latitude on both sides of the equator.

Even its present wide range will doubtless be greatly increased in the future.

Conditions of soil, rainfall (or irrigation) and heat, favorable to full development, existing in some countries, render them pre-eminently adapted to the growth of cane. Such conditions prevail in Hawaii, Java and Cuba, and hence these islands are regarded as veritable sugar bowls. But any country with fertile soils, suitable temperatures and an abundant water-supply, either naturally or through irrigation, possesses every requisite for the growing of sugar cane. Sugar cane, like all grasses does best upon loamy clays or heavy loams capable of holding large quantities of water and filled with organic matter.

Tropical soils with heavy rainfalls are almost universally adapted to sugar canes. Heavy rains induce a luxuriant growth of vegetation which in its transition to humus furnishes simultaneously organic acids which decompose the soil particles into very fine earth. Hence such soils in the course of time become rich in organic matter and very finely divided earth, the latter supplying the mineral, and the former the nitrogenous food, and both (particularly the humus) retaining that excessive moisture so essential for healthy cane growing. Here a valuable lesson may be learned by the sugar cane growers of the Atlantic gulf coasts. By growing and incorporating with your soils heavy green crops, conditions similar to those in the tropics and favorable to large yields of cane, will be established. Our cow pea, a leguminous plant of rapid growth and development, utilizes perhaps more free nitrogen in a given time than any other plant, unless its congener, the velvet bean, now coming into general use, should surpass it. These plants may be successfully grown even upon our poorest soils, with the aid of mineral fertilizers (now abundant everywhere in the South) and should be the precursors of the cane crop and purveyors for it of nitrogen from the air—the one ingredient pre-eminently required for large crops of cane.

After incorporating these crops with the soil, which can easily accomplished by disc plows, cane may be planted. In the open loamy and sandy soils of the coast, cane may be planted flat and cultivated on a level. In the alluvial lands of Louisiana where drainage is of paramount importance, cane is planted and cultivated upon high ridges. The plats are ditched and quarter-drained. The fields are canalled and frequently leveed, and immense drainage machines lift and remove the excessive rainfalls. After a thorough preparation of the soil, the rows are opened with a double mould board plow or large shovel, and into these open furrows in continuous rows, the canes are deposited—one to four, according to the judgment of the planter, and the soundness of the cane. One continuous stalk of good sound cane in well prepared soil and properly covered will, with favorable seasons, produce a good stand. Two such stalks are ample for the securement of an excellent stand, even under the vicissitudes of seasons. The canes may be covered with the hoe, the plow or the cultivator—deeper in the fall, shallower in the spring, followed usually in Louisiana by a heavy iron roller to compress the soil around the cane.

If a fertilizer be used at planting, it should be distributed in the open furrow and well mixed with the soil, before planting the cane.

"Scraping the cane," removing the excessive dirt with plows or hoes, in order to permit an early germination, is universally practiced in Louisiana. After this operation, if the weather be propitious, young plants will soon outline the row, until finally a "stand" is obtained, when cultivation begins.

That cultivation which will maintain the tilth which a previous preparation has established and which will cut as few roots as possible, is best. Frequent shallow cultivations insure rapid and abundant nitrification, conserve moisture and maintain tilth. Late in June or early in July, when the cane reaches such an height as will shade the rows and prevent the growth of weeds and grass, it should be "laid by," i. e., cultivation discontinued.

After lay by, with showers at frequent intervals and hot sunshine—conditions usually obtaining in the South in July and August—the canes grow rapidly and are ready for the harvest in October and November. Should drouth prevail, irrigation can be practiced with excellent results, as has been abundantly proven in Louisiana.

HARVESTING CANE.

In this latitude the cane must be harvested in the fall Grinding usually begins in October or November, and continues without cessation until the entire crop is finished. Cane harvesters have not yet been perfected. Several patents have been issued and these machines are yet in their experimental stages. Though the problem of cutting and stripping canes by machinery is extremely intricate, yet, judging from the past, it will be solved. Whenever humanity rests upon any problem, experience has demonstrated that sooner or later that problem will be solved. While waiting for this valuable machine we are necessitated to continue the exceedingly expensive and tedious method of cutting cane by hand. The stalk is stripped of its leaves, topped, and severed at the ground by a cane knife, and thrown into heap rows (every third row) from which it is transferred to wagons or cars by hand, or cane loaders of which we have 2 or more now on trial for the first time on a large scale. A good cutter in good cane will cut about three tons per day. The canes are now almost universally transferred from wagons to cars, and from cars to the carrier by machinery specially devised for the purpose, thus greatly reducing the cost of labor at the cane carrier.

Fertilizers for cane should contain enough nitrogen to insure a large growth by September. An excess should be avoided, especially where large sugar content is desired. Phosphoric acid in a soluble form in moderate quantities, is very beneficial in Louisiana, while potash may be demanded upon light sandy soils. Experiments in Louisiana have shown the limits of profit in the use of fertilizers are between 36 and 60 pounds of nitrogen and 30 and 40 pounds of phosphoric acid per acre. These ingredients are cheaply furnished in the forms of cotton seed meal and acid phosphate—both easily obtainable everywhere in the South. Where potash be required, doses of 40 to 50 pounds may be used per acre.

The up-to-date process of the *manufacture of sugar* may be briefly described: The cane delivered at the sugar house is transferred by machinery to an endless chain carrier which bears it either to a mill to be crushed, or to knives to be finely comminuted for the diffusion of cells. Both of these processes are practised in Louisiana. Mills are usually combinations of three heavy iron rollers, popularly known as "three," "six" and "nine" roller mills, often prefaced with a shredder or crusher to prepare the cane for the mill and to insure safety against breakdowns by properly regulating the uniformity of the feed. They are so adjusted as to squeeze the juice from the canes in their passage through the rolls. Maceration is almost universally practised. The process consists in saturating with water the canes after their passage through the first mill and before entering the second. Sometimes double maceration is used, i. e., saturating between the first and second, and again between the second and third mills. Some of our mills are exceedingly ponderous, crushing from 1,000 to 2,000 tons of cane per day.

Diffusion, always applied to beets and in recent years to sugar cane, requires twelve or more large iron cells, which are filled with finely comminuted cane and then saturated with hot water. The juice is driven from cell to cell over fresh chips until it contains the desired density, when it is withdrawn and sent to the juice tank for treatment. When a cell has been repeatedly washed until only traces of sugar remain in the chips, it is emptied and at once refilled with fresh cane. To each cell is attached a heater by which the juice is heated as it flows from cell to cell.

TREATMENT OF THE JUICE.

The juice obtained by mills or diffusion, is subjected to the following treatment: If white or yellow sugars be desired, the juice is treated with the gas obtained by burning sulphur. This bleaches it. It is then drawn into large copper vessels holding from five hundred to several thousand gallons, with steam coils at the bottom called "clarifiers." Here it is treated with milk of lime until the natural and added acidity of the juice is neutralized and then heated to near the boiling point of water. This treatment brings to the surface a heavy blanket of impurities which is brushed off into another receptacle and finally sent with the settlings into a filter press, where the juice is expressed and the solid impurities remain imprisoned between the plates of the press. When the filter press is full of this solid substance, it is emptied and made ready for fresh work. The juice is cleared either by settling or passage through filters. Superheaters are now also used for the clarification of juices.

EVAPORATION TO SYRUP.

After cleansing of the juice, it is evaporated quickly to a syrup containing about 40 per cent. of sugar. This evaporation is performed in open pans, or preferably in closed vessels, in each of which a partial vacuum is maintained. Direct steam is used in the former, while the exhaust steam from the engines, pumps, etc., serves the latter. These closed vessels are called "effects," "single," "double," "triple," or "quadruple," according to the number used. The principle of the double effects is this: Exhaust steam is made to boil the juice in the first vessel, where ten to fifteen degrees of vacuum is maintained, the vapors from the first vessel are made to heat the juice in the second vessel, where a vacuum of twenty-eight degrees is held, etc. The vacuum in each vessel can be regulated at the pleasure of the operator, according to the number of vessels used. By this process the evaporation is performed at the minimum expense and at a temperature considerably below the boiling point of water and thus escaping the danger of caramelizing sugar, which is frequently done in open vessels at high temperatures.

VACUUM STRIKE PAN.

By either of these processes a syrup is obtained, which is sent to the vacuum strike pan, where it is granulated. This pan consists of a closed vessel with three or more interior coils, situated one over the other, through which the steam may circulate. To this pan is attached a vacuum pump which removes the air and vapor (as fast as formed) from the pan. The vapor is condensed by a constant stream of water flowing through the pump. When the proper vacuum is obtained, usually twenty-six to twenty-eight degrees, the sugar-maker takes his first charge of syrup, turns heat into his lowest coil and begins again the process of evaporation. By gradual charges enough syrup is received and concentrated to begin formation of the grain. As the pan is filled, the different coils are opened and additional steam turned on. After concentrating the syrup to a sufficient density, small grains begin to appear. These are examined at short intervals by removing a small quantity on the "proof-stick," and when sufficiently numerous, the process of "building the grain" begins. This process is done by carefully feeding them with fresh syrup taken in, in small quantities at short intervals. Finally, the grain has grown to the proper size, the pan is full and a strike must be made. Before the latter is performed, full heat is turned on all the coils; the grains are hardened and the entire mass cooked to the proper density. Then the bottom of the pan is opened and the stiff semi-fluid mixture of sugar and molasses called "masse cuite," is emptied into a large mixer, where revolving paddles keep it from solidifying. From this mixer it is drawn into centrifugals which, revolving at the rate of 1,200 to 1,500 times per minute, throw out through the fine sieves the fluid molasses and retain the sugar.

The molasses is caught in the outer basket and directed to a large receiving tank. After the molasses has been removed, the sugar is washed with more or less water or pure sugar syrup, according to the quality of the sugar desired. In this way brown, yellow clarified or white sugar may be obtained at the option of the operator and are called first sugars.

DIFFERENT GRADES OF SUGARS.

Frequently when yellow clarified sugar is desired, the wash water contains a small quantity of some salt of tin to give the sugar a desirable yellow tint.

The yellow clarified and white sugar thus made go at once into commerce. Sometimes the latter is granulated before offering it on the market. The instrument used is called a granulator and consists of a large hollow revolving cylinder, so arranged that the sugar conveyed into it at one end, is carried slowly through it and during its passage is heated to expel the last trace of moisture. It emerges as granulated sugar and has the advantage of not caking even in the dampest climate. The brown sugar made as above formerly went into consumption as such, but now goes almost entirely to the refinery.

SECOND AND THIRD SUGARS.

The molasses thrown off by the centrifugals in the above operation, is drawn up again into the vacuum pan and cooked to such a density that when a small portion of it is drawn between the thumb and forefinger it will "string" out into fine thread before breaking. When this density is obtained the mass is emptied into iron wagons and rolled into a hot room where a constant temperature of 110 degrees to 112 degrees, Fahrenheit, aids the granulation of the contained sugar. This process is called *cooking to* "string," and its sugars "string sugars," in contradistinction to "grain" and "grain sugars." In a few days the mass becomes charged with crystals and the latter are separated as before by centrifugals. It is almost impossible to obtain other than brown sugars by this process, and of course, they go to the refineries. They are known as second sugars, or seconds. The molasses from the second sugars is again subjected to the same treatment and the sugars therefrom are called third sugars, or thirds.

It has been found in recent years that crystallization takes place more rapidly in a slowly moving mass, hence "crystallization in motion" is accomplished by means of crystallizers in many sugar houses, and the process shortens the campaign of sugar making very materially.

MOLASSES.

The final molasses finds it way to the markets under the name of "centrifugal molasses," and is sold at very low figures. It is black, thick, heavy and uninviting. It contains only a small percentage of sugar. A great deal of it is used for distillation into rum and alcohol, and a much larger quantity for feeding stock.

The above is a description of an up-to-date sugar house. A few syrup houses still survive in Louisiana, and a brief description may not be amiss here.

The process of extraction of the juice is the same as just mentioned. The treatment of the juice with sulphur and lime is also similar, only the acidity is never fully neutralized by lime. After sulphuring and liming the juice is carried to a series of evaporators, or an evaporating pan, each consisting of three or more compartments. In an open kettle sugar house, there are four large kettles known as "The Grand," "The Flambeau," "The Sirop" and "The Batterie." In "The Grand" the scums are removed. In "The Flambeau" the juice is brushed. In "The Sirop" it is thoroughly cleansed, and in "The Batterie" it is cooked to sugar or syrup. In the modern evaporator or steam train, "The Flambeau" is omitted. Every evaporator ought to have three separate compartments—The Grand, The Sirop and The Batterie. A thorough skimming should be accomplished in the Grand. The juice in the Sirop should be well brushed while in violent ebullition, and when well cleansed, should be dipped into the Batterie where it should be concentrated to a density of 34 to 36 degrees Beaume, and withdrawn and permitted to settle thoroughly, and then bottled, canned or barrelled. The great trouble with syrup makers is how to best preserve the syrup. If boiled too thin it will ferment; if boiled too dense it will granulate. In practice, the larger the amount of impurities in the juice or the greater the inversion of sugar present, the less the tendency to granulation and the greater safety in concentrating the syrup! Cutting the cane well up into the white joints will increase the impurities, and heavy sulphuring with a mimimum of lime will increase the inversion. Both are resorted to in order to obtain a dense syrup which will keep and not crystallize. Better yet, it is to put up your syrup in a sterilized condition and it will keep indefinitely, whether thin or dense, until opened and exposed to the air. Fermentation is due entirely to microbes or ferments furnished abundantly in the air. Heat at a temperature near boiling destroys these ferments, and if the syrup be boiled and while hot placed in sterilized bottles and cans and stoppered with sterilized corks and sealed, it will keep indefinitely. Prof. Dodson of our station, has recently issued a bulletin upon the sterilization of syrup, which may be obtained on application to me at Audubon Park, New Orleans. He has also invented a sterilizing faucet, through which syrup may be drawn at any time desired from a sterilized cask or can of syrup, without inoculating the syrup with ferment.

SYRUP IN GEORGIA.

A previous visit to this state during the season of syrup making, and a critical examination of your fields of cane and your method of manufacture, and a subsequent examination of many samples of cane in our laboratory, convinced me of the fitness of your soil and climate to this industry. The superior saccharine richness of your canes, and your abundant and cheap labor, your large supply of cheap fuel, the low prices of your land, and the ease with which it can be cultivated and drained, all suggested to me the possibility of this section making sugar and syrup in competition with the world. The large sugar content of your canes should attract readily the attention of manufacturers of sugar, and central factories would surely come as soon as the farmers would guarantee the necessary cane. A central factory would not only increase the present value of a ton of cane by saving therefrom nearly double the quantity of juice which is now obtained by your small mills, but would furnish a market for many of your other products of the farm which are to-day unsaleable. The community would find a central factory a veritable increment to the volume of busiess transacted. Railroads would not only profit by the transportation of cane to the factory and the sugar to market, but by the increased transportation of all kinds of wares needed by the factory and its clientelle, and the increased travel which a constantly growing population would indulge in. Every environment declares for central factories, and if the local farmers will guarantee an ample supply of cane, few business communities can afford to be without them.

In the absence of central factories, continue to make syrup. Remember three cardinal principles in the growing of cane and the manufacture of sugar or syrup:

1. The sugar is made only in the field; therefore aim to make each acre as productive as your soil, climate and your own intelligence can effect it.

2. After making the sugar in the field, it is almost a criminal waste to leave it in the baggasse or in the scums. Therefore mills should be adjusted to get the largest percentage of extraction possible, and arrangements should be made by which the scums should be greatly reduced in quantity.

3. After getting all the juice possible and decreasing the losses from scums, the operations of concentration and the preparation for market, should be effected in the most approved styles, remembering that attractiveness to-day is demanded in every article which meets with a ready sale.

A good acre of cane in Georgia should yield a least 20 tons of cane. A tone of Georgia cane should give 1,400 to 1,500 pounds of juice containing at least 15 per cent. of total solids, and should yield on evaporation 25 to 30 gallons of syrup.. Thus an acre of Georgia cane should yield at least 500 to 600 gallons of syrup of standard density and weight, if properly handled. With a larger density of the juice which experience has shown actually exists, and an increase in tonnage, 800 or even 1,000 gallons per acre might easily be obtained.—[Louisiana Planter]

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SUGAR CANE TOPS AS FODDER.

These constitute the most important of all fodders in the sugar producing colonies. During crop time they are given to the animals in a fresh condition and are excellent fodder. Towards the close of the crop season considerable quantities of these tops are made into a rough kind of hay by partial drying, followed by stacking in ricks or "top heaps," as they are locally called.

As a good deal of fermentation goes on in these ricks or heaps, amounting in badly packed heaps to actual decay, it has been suggested that perhaps cane tops thus preserved are very imperfect fodder, that the method is accompanied by great waste, and that it would be preferable to make ensilage.

In order to have data for a discussion of the points thus raised, analyses were made of two lots of tops from top heaps, the first lot consisting of selected tops representing the result of careful packing and successful preservation, the other lot being unselected and taken at random. In these latter the butts had decayed to some extent. For comparison an analysis was made of fresh tops, and results calculated on the dry substance (i. e. water free.) We then obtain:

Water-free Composition of cane Tops from Top Heap.		Water-free Composition of fresh Tops.	
		Selected	Ordinary.
Fat	.76	.84	.82
Protein (crude)	5.01	4.72	4.26
Carbohydrates	52.11	54.69	52.67
Fibre	33.96	30.24	35.20
Ash	8.16	9.51	7.05
	100.00	100.00	100.00
True protein	4.16	4.32	3.47

The differences are small and indicate that the cane tops may be preserved satisfactory in this manner.

One factor, however, requires to be taken into consideration, and that is the palatability. Should the changes which take place during the drying and storing in the manner under discussion render the fodder unpalatable, or repugnant, to animals, it is clear that the process is not to be recommended. This, however, does appear to be the case, or to a small extent only, for cattle readily eat the tops thus preserved, particularly when cut into chaff and sprinkled over with molasses, to replace the sugar lost by fermentation.

Under these circumstances of the sugar industry of the Leeward Islands there is no difficulty in saving a very large quantity of useful fodder. In order to preserve the cane tops it is necessary that they be allowed to dry on the cane fields until they have formed a rough sort of hay; they are then tied in bundles and closely packed in ricks or heaps, some skill being requisite in order to pack them sufficiently closely. This fodder has considerable value and warrants the expenditure of some care in providing an adequate supply for the stock of a sugar estate in the period between the crop seasons.

Under these circumstances there does not seem to be any great inducement to convert cane tops into ensilage, whatever may be the position with regard to ensilage with other fodders.

In a tropical country it appears reasonable to suppose, that it will be more economical to preserve fodder in the form of hay rather than in the form ensilage. The practice of making ensilage offers to the farmer of rainy districts in temperate climates a means of saving a fodder crop which runs a risk of being ruined in an attempt to make hay. In the West Indies, in most places there is little difficulty in making hay, and consequently little motive in making ensilage. I attach small importance to the arguments based upon the increased digestibility of ensilage, for this at present is a matter of conjecture. Moreover, even if the digestibility of the fodder is increased by five per cent. it is probable that it will be found an easier matter to give the animals five per cent. more hay than to incur the expense of building and working a silo.

Of course there may be certain rainy districts where it may be necessary to make ensilage rather than hay, and there may be certain succulent crops which it may be preferable to convert into ensilage but, looking at the question broadly, it is safe to assert that, in a moderately dry tropical country hay making is preferable to ensilage. In support of this view I may quote Dr. J. A. Voelcker (Report on the Improvement of Indian Agriculture): "I have gone at some length into the silage question because I differ entirely from the opinions of one of my predecessors, to the effect that India is the great field for the development. That it is the field for hay making I am much more ready to think. With a sun and climate such as exist over the great part of India, I cannot see how it could well be otherwise. Hay requires no making, for it makes itself. Silage, I repeat, will only be useful when, by means of it, can be saved what would otherwise be lost."

It is perhaps almost a matter of misfortune that in some districts fodder is at times so abundant as to give the planter little concern, or even to occasion trouble in the form of invading weeds, while in a period of drouth it becomes so scarce that animals may die for want of it. This superabundance at times leads to carelessness and disregard for the future; little or no hay is made beyond the "top heaps" above mentioned.

I believe that the introducing of a system of hay making would result in better pastures, better cattle, and increased wealth in the country.—Sugar Planters' Journal.

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SOURCES OF SUGAR.

By Dr. C. A. Kern.

Sugar in greater or less quantities is distributed throughout almost the entire vegetable kingdom.

The leaves of the plant are the site of production, which is said to be brought about by the chemical action of sunlight. Some claim the sugar results directly from the action of the chlorophyl in the plant upon the carbonic acid taken from the air, or upon other carbohydrates such as glucose, starch, etc., which have been previously produced and are transported and stored up in other parts of the plants as reserve material.

On the evening of a sunny day, the leaves of a sugar beet contain about 2 grammes of sugar, of which 1 gramme goes to the root. One kilogramme of grapevine leaves contains 16 grammes of cane sugar, besides 17.5 grammes glucose, etc. Cane sugar and glucose always appear together in plants and the relative proportion varies according to the presence of different organic acid. Therefore the cane sugar in very sour or acid fruits is inverted by these organic acids. The quantities of sugars found in various fruits are as follows:

Pineapple	11.33%	Cane Sugar	1.98%	Glucose
Strawberry	6.33%	"	4.98%	"
Apricot	6.04%	"	2.74%	"
Banana, ripe	5.00%	"	10.00%	"
Apple	1—5.40%	"	7—13.00%	"

Sugar is also found in nuts and almonds, figs, melons, chestnuts, clover leaves, onions, oranges, peanuts, timothy grass, etc., but notin sufficient,quantities for manufacture. The scope of this article is only to consider such plants which were and are used in the production of sugar and the above list was only mentioned to illustrate the large amounts of sugar found in ordinary food products. It is a well known fact that honey was the sweetening medium before sugar was known and in this instance the sugar came indirectly from the flowers of all plants.

The oldest sweetening material is undoubtedly the so-called palm sugar from India. This is called "Jaggery or sharkari," and is made from the juice of palms such as the Phoenix sylvestris, cocoanut palms, arenga saccharifera, etc. The sugar palms are planted in rows in dry, fertile land and produce from the 5th to the 30th year. The gathering of the juice commences in November and ends in February. A triangular slit, one inch deep and six inches long is made under the lowest branches, and a hollow bamboo cane is fastened to the lowest corner of the slit. On the other end of the bamboo is an earthenware pot. The next morning before sunrise this pot contains a thin, very sweet solution of cane sugar. After drawing the juice for three days, the tree must have a rest. One tree can produce from 35 to 40 pounds of sugar in one year. This juice is now boiled down in earthenware pans, sometimes lined with a little lime, and then it is poured into flat dishes made of palm leaves, in which it is dried in the sun. The total annual production amounts to 50,000 tons.

In the temperate climates of North America the maple is the sugar producing tree. The time of gathering is in the early spring, after the snow has gone and when the leaves are sprouting. This period lasts not over five or six weeks. Holes two or three inches deep are bored into the trunk and one end of a pipe is fitted into these holes, the other end running to a vessel. The juice runs freely for several hours, and then after some hours of rest again runs freely. After cold nights and sunny days the trees give off the greatest quantities, as high as twelve quarts. The juice is evaporated and, after skimming down, is poured into square moulds. The manufacture of maple sugar was first carried on by the Indians, especially the Delawares.

Before the arrival of the Spaniards in Mexico and Peru, the natives made sugar-juice and also sugar from the corn plant, Zea mays. The sweet corn plant was pressed and the juice concentrated and cooled. In Toluca, Mexico, the manufacture is still going on, only the juice is fermented and distilled to "Pulque de Mahis," a well known beverage. The best sweet corn contains as much as 10 or 12 per cent. of sugar.

Sorghum (sorghum saccharatum) comes from Central Africa and was known to the old Romans as a sugar-producing plant. In China sorghum has been cultivated since olden times. There the juice is used direct or is fermented into a beverage. In the west of our country, sorghum was cultivated and a sugar factory was started and kept running for several seasons.

In 1400 and 1500 licorice root was used for the manufacture of sugar.

According to Ibn-al-Awan, the Arabs condensed the juice of the grape in copper kettles, and after clarifying, poured it into flat earthenware dishes and collected the crystallized sugar. This industry was revived through an edict of Napoleon I., in which he offered a premium of 200,000 francs for the first grape sugar factory which produced a certain quantity of sugar. Five hundred pounds of grapes gave either 100 pounds syrup, 70 pounds raw or 35 pounds refined sugar.

St. John's Bread (ceratonia siliqua) has been used in Africa and Arabia as a substitute for sugar. The solid paste or syrup was used for canning fruit.

The juice of the birch tree (betula alba) has been used for the production of sugar in Scandinavia, Scotland and Ireland, and also the so-called Syrian dog cabbage (asclepias gigantea). Sugar melons have also been tried in Russia, California and Hungary. Malt has been proposed as a sugar producing material. Mostly all these processes are now historical and there are only two materials, which are the sources of our enormous sugar production, namely cane and beet.

Of these two, cane is the oldest and possibly originated in India on the river Indus. It was first mentioned in a report of Nearchose, Admiral of Alexander the Great, in which he stated that the natives produce honey and a white, sweet substance from a reed or cane. From India it was brought to the Euphrates, then to Egypt, Cyprus, North Africa, Spain, Canary Islands, and from there to America.

The sugar beet (Beta cicla) grows wild on the shores of the Mediterranean and Caspian seas, in Mesopotamia and East India. From these places the sugar beet spread all over Europe In 1747 the German Chemist Marggraf discovered and produced the first sugar from beets, as is stated in a report made to the Berlin Academy of Science. In 1786, Achard, a scholar of Marggraf raised sugar beets especially for the manufacture of sugar and built the first beet sugar factory, the first output of which amounted to 1600 pounds of raw sugar.—Federal Reporter.

SEEDLING CANES.

A larger appreciation of seedling canes, that is, canes raised from seed as distinct from those propagated by means of cuttings or tops, is becoming apparent in the West Indies. At first seedling canes were regarded with a certain amount of suspicion and it was only under force of circumstances that the planters at Barbados and Antigua took up the cultivation of seedling canes on a large scale. In those islands the Bourbon cane that had been exclusively planted for nearly 100 years had become so susceptible to the attacks of fungus diseases that its further cultivation was impossible. Elsewhere, as in Jamaica, British Guiana and Trinidad, the Bourbon cane has not been so seriously attacked by fungus and hence in those colonies the planters, except in a few instances, have not been compelled at once, to take up seedling canes. They have, fortunately, been in a position to discriminate at leisure between the relative merits of seedling and other canes and to choose those only that promised the best results on a commercial scale.

The results of the very careful and complete experiments carried on for so many years with seedling canes at Barbados, Antigua and St. Kitt's, and immediately published for the guidance and information of the planting community, have been of great service in those islands. A feature of great importance in regard to these experiments is the fact that the planters themselves have taken so large a share in testing seedling canes on a considerable scale on their own estates. At the present time probably a larger area is under effective cultivation in seedling canes at Barbados, Antigua and St. Kitt's than anywhere else in the tropics. Also the results have been made accessible, not only in detail, in annual folio reports, but also in the summarized pamphlet form wherein the main facts alone are given.

A new feature introduced into the Barbados Pamphlet Report for 1902 was a comparison between the results in that year and those of the years 1900 and 1901. The planters now clearly understand that the position occupied by a seedling cane in one year's experiments must be carefully compared with the position it occupied in the experiments of previous years. There is thus no danger of hasty generalization from the results of any one year. Meanwhile, the planters are taken into confidence, they know exactly what is going on and are furnished with the most recent facts likely to be of interest to them.

In a return recently issued by the Board of Agriculture in British Guiana, it is evident that in that colony there are seedling canes of considerable promise growing on land where the Bourbon cane does not flourish. In other words, in some parts of British Guiana, as at Barbados and Antigua, it has been found necessary to substitute seedling canes for the Bourbon cane in order to produce a high yield of sugar. In the Demerara Daily Chronicle for January 10, the manager of the important Diamond Estate is quoted as stating that about 2,000 acres of seedling canes are under cultivation by him, and as a rule "we have found them rather better all round than the Bourbon." In the Agricultural Summary for 1902, published in the Demerara Argosy of January 3, a correspondent states that about 7,500 acres are under seedling canes in British Guiana, but "so far it cannot be said that any seedling cane has been grown which in all round good quality is equal to the Bourbon." This appears to contradict the opinion expressed by the manager of the Diamond plantation, but the Argosy correspondent goes on to say "the majority of the seedlings, however, are hardier, and most of them ratoon better than the Bourbon, and on poorer soils they have given returns in excess of those obtained from the Bourbon grown under similar conditions."—Barbados Agricultural News.

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TREATMENT OF INSECT PESTS.

There is hardly any branch of agricultural work connected with the West Indies that deserves more attention than the successful treatment of insect pests. It is estimated that he total loss to crops attributable to insect pests in each of these colonies amounts to several thousands of pounds yearly. The sugar-cane is attacked by the moth-borer, the root-borer and white and black blights. Orange, lime and mango trees and cocoa-nut palms are seriously affected by scale insects, cacao by borer beetles and thrips, Indian corn by caterpillars and moth-borer, sweet potatoes by a weevil.

The mode of attack and the best method of treatment of these and other pests have received considerable attention at the hands of the Imperial Department of Agriculture.

Probably the simplest way of dealing with insect and other pests is to adopt nature's method and obtain disease-resistant or immune plants, that is, those that do not easily succumb to the attacks of disease. It is hoped by these means to obtain disease-resisting canes, as well as disease-resisting coffee, cacao, maize, cotton, sweet potatoes, onions.

One of the first insect pests to be exhaustivly dealt with by the Department was the moth-borer in sugar-cane. This was discussed in a pamphlet (No. 1, issued in May, 1900), and subsequently in an important article in the West Indian Bulletin, (Vol. 1, pp. 37-53). In these, Mr. Maxwell-Lefroy was, it is believed, the first to point out, exactly, where the eggs of *Diatraca saccharalis* were laid and to complete the life-history of a pest that had caused serious injury to the sugar-cane for nearly a hundred years. The sugar-cane borer can now be effectually dealt with by collecting the eggs, as well as by cutting out 'dead hearts,' that is, the early shoots injured by the grub.

In order to familiarize cultivators with the general methods of dealing with injurious insects there was issued in April, 1901, a pamphlet (No. 5) containing brief directions for the destruction of field and garden pests. It was pointed out that the selection of methods dealing with such pests depended on a knowledge of the habits of the insects, and that the methods adopted required to be modified to suit the habits of the different insects. It was convenient to attack some insects at one particular stage. Thus, boring insects for instance were often well hidden in their early stages but emerged when they become perfect; then they could be caught. On the other hand, it was easier to destroy the caterpillars that ate some plants than it was to kill the butterflies or moths into which they eventually turned. Occasionally the egg was the most readily-destroyed stage in an insect's life. It was desirable, therefore, that full advantage should be taken of all these points.

Insect pests may be roughly divided into three classes, viz: leaf-eating insects, boring insects and sucking insects. In the first category are numerous caterpillars or "worms" and grasshoppers; in the second are the grubs of moths and beetles; and in the third are possibly the most destructive insect pests in the West Indies—the plant lice, mealy bugs and scale insects.

Of scale insects there are 120 species known in these colonies and about fifty of these are more or less injurious to economic plants. The prominent position thus shown to be occupied by scale insects led to a special study of this group. In July, 1901, there was published (Pamphlet No. 7), the first part of a study of "The Scale Insects of the Lesser Antilles." This contained a description of twenty species of scale insects, together with hints as to preventive measures, remedies, application of washes and a list of the plants more commonly attacked. There is now in the press, and will be issued in the course of a few days, (Pamphlet No. 22) the second part of a study of "The Scale Insects of the Lesser Antilles." These two pamphlets if rightly used should prove invaluable to those whose crops are attacked by scale insects and it is hoped that the preventive measures and remedies suggested, after careful trial of their efficacy, will be generally adopted in these colonies. A fuller and more scientific study of West Indian scale insects is contained in two important articles in the West Indian Bulletin. (Vol. III, pp. 240-70 and pp. 295-319.)

The attack of thrips on cacao is another matter that has, and is still, receiving attention. It now appears that cacao in nearly all the West Indian Islands is more or less attacked by this pest. It is present in St. Vincent, St. Lucia, Dominica, Guadalupe and Jamaica. It is hoped it is absent from British

Guiana. It is not a very serious pest, except in certain districts in Grenada.

The further efforts of the Department will now be directed to encourage the practical application in the field and garden of the recommendations contained in the publications above referred to. Spraying machines and insecticides are already in use and it is hoped during the coming year the cultivator will be placed in a better position than formerly in regard to insect pests and as a result that he will enjoy a larger share than hitherto, of the proceeds of his labor.—Barbados Agricultural News.

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THE AUSTRALIAN LADYBIRD BEETLES.

The modern introduction of ladybirds into other countries to destroy plant-injuring pests reads almost like a fairy tale, and is one of the romances of practical entomology—setting one insect to fight another.

In 1888, Mr. Albert Koebele was dispatched to Australia by the United States Department of Agriculture, to look for and report upon any natural parasites he could discover destroying the Cottony Cushion or Fluted Scale (Neerya Purchasi) which some years before was introduced probably from New Zealand or Australia, into the citrus orchards of California, where, untrammelled by the many parasites that infest it in this country, it had increased into such multitudes that they threatened to make orange-growing in California a thing of the past. The marvelous success that attended Koebele's mission is related in the notes upon Novius cardinalis, which he collected and sent to the orchards where they increased more rapidly than the scales.

The interest excited in all quarters by the introduction of ladybird beetles into America led to several other expeditions to Australia, and quite a boom set in for the interchange of specimens. The Australian entomologists had quite a run on their species; the tea-planters and coffee-planters of Ceylon and India asked for them to destroy mealy bug and scale; from the Cape of Good Hope came requests for others; and Egypt and Portugal, in turn having introduced Fluted Scale into the gardens and orchards, applied for ladybirds to check it. Later results, in many instances, have not been as successful as in the first instance, frequently through the mistaken idea that any kind of ladybird would feed upon any kind of scale; when, as a matter of fact, each species of Coccinella has a marked partiality for some particular group of aphis or scale insects; so that it is quite useless sending a species that feeds upon aphis or mealy bug to destroy a hard Aspidiotus scale.

The Australian insect fauna is very rich in representatives of the leading groups of the great family Cocinellidae (ladybirds), which in their native hunting grounds keep in check multitudes of scales that infest our indigenous plant life; and though we have quite a number of the large soft-bodied coccids, commonly known as "mealy bugs," peculiar to Australia, they cause little or no damage to either cultivated or native vegetation, owing to the attacks of the ladybirds and other parasites. Now in nearly every other agricultural country native mealy bugs are more or less destructive, but when a strange specie arrives with some introduced plant and successfully brings forth her immense brood, protected under her body, unimpeded by the natural enemy that has been left at home, it soon becomes a fearful pest, particularly in a country where native ladybirds are scarce.

The ladybirds hold their own place in the scale of nature, are valuable allies to the agriculturist, and should be protected and preserved in every way; but they cannot do impossibilities, and no words are used oftener than "exterminate" or "eradicate" in a wrong sense when applied to the destruction of insect pests. We can with care keep out new insect pests by a strict system of quarantine, but when once a pest has become established we cannot eradicate it, we can only check it so far that it becomes harmless, and if we once stop the fight it soon asserts itself again, and this particularly applies to all such minute creatures as scale insects. Even where ladybirds are plentiful, and appear to have eaten up all the surrounding scale, the hidden larvae that have escaped appear in the following summer, and if they get a fair start before the ladybirds appear will soon overrun the plant. It stands to reason that if all the coccids were devoured this season there would be no food next year, and the beetles would have to move on or starve. It is not that the ladybirds have not been, and will always remain, useful, but we have been over-sanguine, and expected too much from them without understanding how altered conditions of climate and surroundings affect them; so that even with the ladbirds we shall have to spray or fumigate, at any rate for such scales as Red Scale and San Jose.

Over 2,000 species are described from all parts of the world, comprised in some 140 genera, many species of which have an extended range, while others are comparatively local. Lea gives a list (including a number of new species described) of 110 species from Australia.—Ex.

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THE SUGAR HOUSE.

Preparation of Sugar Cane for Milling.

The increased tonnage of cane necessary to pass through our mills, due to an effort to get the greatest amount of work out of a given milling plant, and the increasing necessity for getting the largest possible percentage of juice extraction, due to the decline in the price of sugar, led to the development of special machines for the preparation of the sugar cane immediately previous to its milling. These machines having for their special objects an improvement, or increase in the grinding capacity of the mill by facilitating the feeding of the same, and an increase in the juice or sugar extraction, by reducing the cane to a condition favoring more uniform distribution of the pressure of the rolls over the surface of the feed, and by a proper rupture of the stalks which would favor the free exit of the juice from the cane cell while undergoing the process of rolling, or "grinding," as it is ordinarily mis-called.

The most prominent efforts in this direction resulted, first, in the "Shredder," consisting essentially of two rapidly revolving cylinders divided into "V" shaped sections. The "V" shaped conformations with "V" shaped teeth, but upon their fitting into each other and run close together at high but greatly unequal velocities. The teeth of the slower cylinder, which is the top one, holding the cane back while the teeth of the faster one tears or shreds the stalks of cane. These two cylinders are placed one above the other, the top and slower one capable of a lifting movement, when the size of the feed demands this, and this movement being resisted by the weight of the cylinder and the tension of open coil steel springs placed above its boxes. The strength of these springs being about equal to the weight of the cylinder. As an instance of the speed of the cylinders, the lower one runs about 1,280 feet periphery speed per minute; the faster one runs at about 2,250 feet per minute.

The second system is by the use of the "Crusher," of which there are several forms, all consisting essentially of two cylinders rolling against or near each other, held together by great pressure, moving slowly, about the same as ordinary mill roller speed, say 20 feet per minute. These cylinders are provided with various forms of teeth or corrugations, some of which corrugations run parallel to the axes of the cylinders, others runinng more or less spirally around; others with oblique wavy corrugations. In all of the "Crusher" class, the corrugations do, or are intended to, shear the cane in short lengths, usually corresponding to the length of the cane joints (these being the weakest points of the stalk.) All machines of the "Crusher" class extract a large portion of the juice as a necessary result of their construction. They also greatly compact the feed and materially reduce its volume; none of them turn the cane inside out.

These two systems, the "Shredder" and the "Crusher," are as radically different in principle and detail as two machines could well be, to secure practically the same results. The first of these machines on the market was the "Shredder," one of which was placed on the Magnolia plantation about one hundred feet down the cane carrier from the mill. This machine had a high speed carrier feeding it, carrying out the original idea of the designer, that there should be a high speed and a very thin or light feed, in which manner there would be a minimum quantity of cane under treatment in the machine at a given time. (This idea has not always been properly carried out.) This machine shredded the cane to a fine stringy mass with such perfect rupture of the cane that a large portion of the juice escaped dripping from the cane carrier, estimated at that time at about two per cent. of the total mill extraction. The machine was afterwards moved to a foundation at the head of the chute to recover this waste of juice, and in this manner all subsequent "Shredders" have been erected. The original machine is now in position on the Scarsdale plantation.

While the advocates of the two systems of preparing the cane each have their claims, it appears that there is no material difference in the real value of the two. The following appears to be a fair statement of the results accomplished by the two systems, assuming that both are doing their best work. In the case of the "Shredder," the cane is thoroughly torn to pieces, a great portion turned inside out, which is an excellent feature, as the cane is thus in better condition for the escape of the juice, and there is much less of the rind of the cane presented to the mill rolls, which is a fruitful source of slippage and the principle cause of mill wear, and while the volume of the feed is increased, the shredded cane partakes of the nature of straw, and the feeding of the mill is greatly facilitated thereby. The shredding greatly tends towards uniformity of the feed. The juice extraction with a "Shredder" is not an object, but an incident.

In the case of the "Crusher," the volume of the feed is greatly diminished by the compressing action of the rollers and the escape of a large portion of the juice, often estimated as high as forty per cent. There is a great tendency towards making more uniform the otherwise irregular feed at the mill. It is often said that the work or strain on a sugar mill is greatly relieved by previous preparation of the cane, but aside from the shocks and strains due to mill slippage, which occur with, as well as without, previous preparation, this cannot well be the case, as the strains on the mill and the power consumed depend upon the working condition of the mill, its speed, and pressure applied to the feed, and is independent of all other conditions.

Of the two systems, the "Shredder" places the cane in the best condition for subsequent saturation, by reason of allowing most of the inner part of the cane to be presented on the surface of the feed. The extraction of the juice by a preparatory machine does not necessarily have any effect on the amount of juice finally left in the bagasse, as this amount depends on the uniform application of the pressure to the feed, condition of the cane, time of exposure to the pressure, amount of pressure applied, and amount and character of saturation used, regardless of the amount of juice in the feed at the beginning of the milling treatment. Of the power consumed by the two systems, on equal work, this is decidedly in favor of the "Shredder," under average conditions. This is perhaps but little over half of that ordinarily used by a "Crusher" doing the same work.

The writer has shredded 525 tons of cane for twenty-three hours on five foot "Shredder" for a "4-6" mill, and the same "Shredder" would have handled perhaps 800 tons. As far as comparisons between the two machines, a five foot "Crusher" should do this, or perhaps more, but with the use of materially more power. Among all these forms of preparation, there is none that is not beneficial. Most of our mills are supplied with some form of preparatory machine, and all should be. The industry could not have held its place nearly so well without assistance of these machines.—J. O. Frazer in Louisana Planter.

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ELECTROLYSIS IN THE SUGAR INDUSTRY.

CHARLES E. COATES,

(Louisiana State University, Baton Rouge.)

In view of the interest shown of late in the possible application of electrolysis in the sugar industry, these notes on some of the most recent of such processes may be of interest.

Of the various methods proposed, but few have been tested with cane juice, and the problems involved here are radically different from those involved in the purification of beet juices. Moreover, it has been difficult to get unbiased reports of the actual working of these processes, largely because they are all hardly past the experimental stage. They are of two general types, those involving the use of soluble electrodes and those in which the current has a direct oxidizing effect, either by the production of ozone or else by influencing the action of some oxidizing agent, such as calcium manganate, etc. The reports on these latter processes are distinctly favorable, but the theoretical explanation given leaves something to be desired. This is not to be wondered at, as the possible reactions are both intricate and obscure. More work along these lines is needed, and is now being given. It is as yet early to hazard an opinion.

Those processes using soluble electrodes, as a rule use either lead, or lead and antimony alloyed, zinc or a zinc alloy, or aluminum or some aluminum alloy. The lead, antimony and zinc processes all seem to work well, giving a good clarification and a juice which boils well. Nevertheless, lead, antimony and zinc are all three poisonous, and although they are not supposed to pass into the final products, the consensus of opinion seems to be that the danger is too great to justify their general use. If good results could be obtained from the use of aluminum electrodes, this objection would not hold. It was with this idea in view that a process of this nature was given some attention recently in this laboratory, the actual work being carried out by Mr. Thomas D. Boyd, Jr., factory chemist of "Calumet" plantation. [An account of the aluminum magnesium alloy of Capt. John M. Murphy appeared in the April number.] This process was devised for the purification of water, and was tried by Capt. Murphy on sugar juices for the first time within the past few weeks. It was frankly stated by him to still be in the experimental stage. The solutions tested were as f llows:

1. Juice—from seed cane.

There was unfortunately only a limited quantity of this available—not enough to carry out complete quantitative experiments. On passing the current the juice frothed considerable, but was bleached and clarified—aluminum hydroxide separating from the electrodes, mixed possibly with magnesium hydroxide. (This point was not investigated.) The juice filtered through paper with difficulty. The filtered juice was bright, and showed a distinct increase in purity. We have no data as to the cost of the process, nor as to the possibility of filtering the juice commercially. It is well known that aluminum hydrate is a good clarifying agent, but in this case the action is doubtless deeper seated than in the mainly mechanical action of the hydrate. This point will be given further attention next fall as soon as a supply of cane becomes available.

2. Syrup—a sample of Dunbar's bottled syrup diluted to 14.7 Brix—Purity 74.1.

This was treated with a current of about 1.2 amperes per square decimeter electrode surface for two minutes. There was no marked result. The current was then increased to 3.6 amperes per square decimeter. The solution was bleached unconsiderably. Filtration was difficult, and the purity was unchanged.

3. Raw sugar and black molasses were mixed thoroughly and diluted with water—Brix 37.1, Purity 90.45.

This was treated with seven amperes per square decimeter electrode for five minutes. No marked change. Purity unaltered, being now 90.35. Filtration difficult.

4. Third molasses—diluted to 28.53 Brix, Purity 56.9, treated 15 minutes with five amperes per square decimeter. No marked change in color or purity. Purity 56.7.

In certain experiments the current was increased very considerably over the above figures, but while there was more bleaching effect, in no case was the purity increased. These results would tend to show that under the conditions specified, syrups and melted sugars are not affected one way or the other by this process. In regard to the cane juice itself, the chemical conditions are somewhat different, and it is as yet too early to pronounce judgment. We understand that the process is to be tested practically in Cuba. The results of the test will be looked forward to with considerable interest.—Louisiana Planter.

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THE SUSTAINING POWER OF DEMERARA SUGAR.

Sir Martin Conway's recently published book, "Aconcagua and Terra del Fuego," contains an unsolicited testimonial as to the sustaining power of genuine Demerara sugar, which is so striking that we are prompted to quote it at length. At pages 47-48 he says:

"At higher levels only light foods can be eaten with advantage. * * * More important perhaps than all these was a great tin of coarse brown Demerara sugar, the finest heat producing, muscle nourishing food in the world. For men taking violent exercises, such as soldiers on active service or athletes in training, a plentiful supply of sugar is better than large meat rations. A quarter of a pound per man per day is my allowance on the mountain side, and I am inclined to think it might be increased to nearly half a pound with advantage, cane sugar being, of course, selected for that purpose."—London Produce Markets' Review.

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AMERICAN BEET CROP ESTIMATE.

The American beet sugar factories have now finished their campaign. Willett & Gray have obtained from the best sources reports of the results for the season 1902-03, as follows, the last column showing the number of tons (2,240 lbs. to a ton) of sugar produced:

States.	Factories Operated.	Tons.
New York	2	2,799
Wisconsin	1	3,463
Ohio	1	1,473
Michigan	16	48,848
Minnesota	1	3,054
Nebraska	3	9,430
Colorado	5	34,623
Utah	6	16,987

Oregon	1	2,025
Washington	1	1,641
California	7	71,120
Total	44	195,463
Total, 1901-2	39	163,126

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WORLD'S SUGAR PRODUCTION AND CONSUMPTION.

The following figures, from Willett & Gray's Statistical, are based on actual stocks in principal countries at the beginning of the campaigns 1900-01, 1901-02, and 1902-03, and on the latest estimates of world's production each campaign. The apparent heavy increase in the consumption during 1901-02 is due to the large invisible stock accumulated in the United Kingdom in anticipation of tariff changes, and since drawn on to such an extent that imports during the last six months show a reduction of 500,000 tons. Willett & Gray, therefore, estimate but little increase in the consumption in 1902-03 over the apparent consumption during the previous campaign. After September 1, 1903, the actual consumption in European countries should increase considerably as a result of the abolition of bounties and consequent cheapening of sugar for the home trade:

	Tons.
Stock, September 1, 1900	525,465
Production, 1900-01	9,752,909
Supply, 1900-01	10,278,374
Consumption, 1900-01	9,412,444
Stock, September 1, 1901	865,930
Production, 1901-2	11,028,737
Supply, 1901-02	11,894,667
Consumption, 1901-02	10,121,537
Stock, September 1, 1902	1,773,130
Production, 1902-03	9,756,275
Supply, 1902-03	11,529,405
Estimated consumption, 1902-03	10,229,405
Estimated stock, September 1, 1903	1,300,000

CONSULAR REPORTS.

In the consular correspondence from various countries we notice some data here and there which may be of interest to our readers. From St. Petersburg, the consul writes that "The yield of beets for the fiscal year ended November 1, 1902, according to statements of the Ministry of Finance, is 537,617,730 poods (8,741,589 tons), or 7.3 per cent. more than for the same period last year, but owing to a cold and rainy season 21 per cent. of the total amount remains unharvested. The beets are of a higher quality than those of last year in the southwestern and central region, and inferior in the Vistula region. A circular published in the Messenger of the government estimates the production of white sugar at Russian works for the six months ended October 25, 1902, at 73,727,706 poods (1,198,824 tons), which includes 7,041,528 poods (114,496 tons) surplus of the previous period. In accordance with the decree of July 3, 1902, 43,000,000 poods (699,187 tons) must be stored in reserve, thus allowing only 30,000,000 poods (499,637 tons) to be placed on the Russian market. It is further ordered that 54 per cent. of the total production be deducted, allowing 11 per cent. for the intangible reserve and 43 per cent. for the marketable reserve. The sugar refiners are to be instructed accordingly."

The Consul-General at Berlin writes to the Department of State as follows: "Beyond question the most interesting feature of the present situation is the area of sugar-beet planting throughout Germany and the other sugar-growing countries of Europe. The syndicate of German sugar producers have held a meeting and sent out an earnest demand that beet growers should reduce as far as possible their beet planting for 1902, and thus aid to make headway against the enormous surplus that now overloads and depresses the European market. * * * Every province in Germany shows a decrease, and the reduction of acreage ranges from 1.2 per cent. in Pomerania to 36 per cent. in Baden, 45 per cent. in Bavaria, and 54.1 per cent. in Hesse-Nassau. Four factories, viz., Hattersheim, Hunfeld, Ossendorf and Fiddichow, are shut down and will remain closed during the coming campaign, so that there will be only 392 German factories in commission, against 396 during the past year. Reports from the other European sugar-producing countries show the following variations of beet area as compared with last year:

Country.	Area. Acres.	Decrease. Per cent.
Austro-Hungary	751,011	16.2
France	551,774	23.8
Russia	1,470,566	....

Belgium	130,516	24
Holland	77,009	35
Sweden	59,887	16.4
Denmark	35,830	....

Four factories in Belgium and eight in Holland will suspend operations during the campaign 1902-3, and the mean average reduction in the area of beet cultivation in these eight sugar-growing countries of Europe will be 11.34 per cent. of the total beet acreage of 1901.

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NEW INVENTIONS.

Reported especially for this paper by H. B. Wilson & Co., Patent Attorneys, 8th and F streets N. W., Washington, D. C.

A complete copy of any of these patents will be forwarded to any person by Messrs. Wilson & Co., on receipt of ten cents. Persons ordering copies must give number of patent.

723,990. PROCESS OF BOILING SUGAR SOLUTIONS. Hermann Claassen, Dormagen, Germany. Filed Aug. 25, 1902. Serial No. 120,-992 (No specimens.)

Claim.—The process for controlling the oversaturation during boiling of saccharine juices, especially thick or concentrated juices, consisting in keeping up a systematically-varying oversaturation, empirically determined, according to the purity of the saccharine solution, establishing a decrease in oversaturation after formation of grain, followed by a systematic increase of the oversaturation preparatory to boiling off according to the dropping purity of the mother-syrup.

724,930. APPARATUS FOR MOLDING SUGAR. Heinrich Passburg, Moscow, Russia. Filed Sept. 10, 1902. Serial No. 122,765. (No model.)

Claim.—1. In an apparatus for covering and drying sugar in molds, the combination of a plurality of molds, a pipe connecting the ends of said molds, means for rotating said molds and pipe, and means for producing a partial vacuum in said molds and pipe, substantially as set forth.

2. In an apparatus for covering and drying sugar in molds, the combination of a plurality of molds, a pipe provided with laterally-extending tubes connecting the ends of said molds, means for rotating said molds and pipe, and means for producing a partial vacuum in said molds and pipe, substantially as set forth.

3. In an apparatus for covering and drying sugar in molds, the combination of a plurality of molds, a pipe connecting the

ends of the molds, means for rotating the molds and pipe, means for producing a partial vacuum in said molds and pipe, a second pipe located below said molds and provided with a plurality of openings, tubes extending upwardly from said openings, an interiorly-threaded sleeve on said tubes, having exterior handles, and an adjustable screw-threaded socket adapted to be raised or lowered by the turning of said sleeve, substantially as set forth.

4. In an apparatus for covering and drying sugar in molds, the combination of a plurality of molds, a pipe connecting the ends of the molds, means for producing a partial vacuum in said molds and pipe, means for rotating said molds and pipe, troughs containing covering material, and means for suspending said troughs from the molds, substantially as set forth.

5. In an apparatus for covering and drying sugar in molds, the combination of a plurality of molds, a pipe connecting the ends of the molds, means for producing a partial vacuum in said molds and pipe, means for rotating said molds and pipe, a second pipe below said molds and provided with a plurality of tubes corresponding to the number of molds, funnels on said tubes and adapted to fit said tubes and molds, means for raising said funnels upwardly toward the molds for permitting a continuous current of air to pass through the lower pipe, molds and connecting-pipe, substantially as set forth.

724,620. MACHINE FOR CUTTING SUGAR-CANE OR SIMILAR CROPS IN THE FIELD. Henry W. Schmidt, Honolulu, Hawaii. Filed Apr. 5, 1902. Serial No. 101,563. (No model.)

Claim.—In a machine for cutting sugar-cane, that is adapted to be pushed forward through the field, a bracket projecting from its front end, a vertical shaft journaled in said bracket and carrying a cutter at its lower end and a gear at its upper end, a second cutter co-operating with the first, said second cutter having a gear fixed to it and being loosely journaled on the vertical shaft, a cutter-driving motor mounted on the machine-frame, and a fore-and-aft shaft operated by the motor, said shaft having a driving-gear located between and meshing with the gears on the vertical shaft.

725,796. BEET-WEEDER. Joseph B. Strehl, Owosso, Mich. Filed Mar. 20, 1902. Serial No. 99,201. (No model.)

Claim.—1. A beet-weeder comprising an axle having supporting-wheels, a tongue connected to the axle, a frame extending above and projecting forwardly from the axle, spring-arms pivotally connected with the frame in advance of the axle and having hoes at their lower ends, and levers mounted upon the frame and connected with the hoes for manipulating them.

2. A beet-weeder comprising an axle having supporting-wheels, a frame connected to the axle and extending above and forwardly from the axle, spring-arms pivotally connected to the frame in advance of the axle and having hoes at their lower ends, bars connected each with a group of arms, levers mounted upon the frame and connections between each lever and a bar for raising and lowering the hoes.

725,811. CANE CUTTING KNIFE AND STRIPPER. Noah Asbell, Ochlochnee, Ga. Filed Jan. 15, 1903. Serial No. 139,175. (No model.)

Claim.—1. A combined cutting and stripping instrument comprising a blade, and yieldable inspringing stripping blades at the outer end thereof projecting rearwardly therefrom, substantially as described.

2. A combined cane cutting and stripping implement, comprising a blade having a stripping-blade projecting rearwardly therefrom, and a spring-plate on one side of said first-mentioned blade and provided with a stripping-blade disposed opposite and adapted to coact with the first-mentioned stripping-blade, substantially as described.

3. In combination with a cutting-blade and inspringing stripping-blades carried thereby, means to limit the movement of said stripping-blades from each other, substantially as described.

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PROFITS OF GERMAN INDUSTRIES IN 1902.

The Department has received from Consul T. J. Albert, of Brunswick, Consul Walter Schumann, of Mainz, and Consul H. W. Harris, of Mannheim, statement of the dividends paid by some of the principal industrial undertakings in Germany for the year 1902 as compared with the preceding year. Most of the industries, it is noted, show a falling off in profits. The textile line and the porcelain and glass industry show some improvement, while the chemical industry about holds its own, and upon the whole makes a favorable showing.

The average dividend paid by stock companies in the more important branches of manufacturing in 1901 was 7.98 per cent. In 1902 the same industries paid an average dividend of 6.69 per cent., or a falling off of 1.29 per cent.

The following table shows the figures given for some of the principal industries as carried on by stock companies:

Description.	Average dividend paid in 1901. Per cent.	Average dividend paid in 1902. Per cent.
Porcelain and glass....	12.93	12.98
Chemical manufacture...	10.43	10.39
Mining and blast furnace....	9.66	7.73
Sugar manufacture....	10.88	7.64
Brewing business....	9.4	8.86
Textile industry....	2.91	4.69
Machine manufacture....	6.13	4.77
Electrical industry....	5.92	4.13
Cement industry....	5.24	4.51
Paper industry....	8.76	8.76
Milling industry....	3.09	1.47

Mr. Albert adds:

It is generally believed that the turning point in the business depression in Germany has been reached, if not passed. Many corporations which had fallen into financial difficulties have been reorganized and put once more upon a stable foundation.

American orders have been instrumental in reducing the surplus stock of the iron and steel companies. Building enterprises are being undertaken, and there is a demand for construction material. The number of applicants for labor at the Government employment offices has decreased. The passage of the new tariff law has removed an element of uncertainty, and, with the new commercial treaties which are being negotiated, the impression prevails that business will once more assume a normal condition.—Consular Reports.

FLUCTUATIONS OF PRICES OF SUGAR, MAY 12 TO JUNE 12.

Centrifugals						Beets					
1903			1902			1903			1902		
May	12..	3.695	May	12 .	3.4375	May	12	8s 4½d	May	12	7s 4½d
"	14..	3.704									
"	16..	3.695				"	13	8s 3¾d			
"	19..	3.6875	May	19..	3.4062	"	16	8s 4½d			
"	23..	3.63				"	21	8s 3¾d	May	19	7s 4½d
"	28..	3.625	May	26..	3.4375	"	22	8s 3 d			
June	2..	3.597	June	2..	3.4375	"	29	8s 2¼d	May	26	7s 1½d
"	3..	3.60				June	3	8s 3 d	June	2	7s 1½d
"	5..	3.592				"	5	8s 2¼d			
	11..	3.597	June	9..	3.50	"	6	8s 1¼d	June	9	7s 4½d
						"	11	8s			

PLANTATION DIRECTORY.

ISLAND AND NAME.		MANAGER.	POST OFFICE.
OAHU.			
Apokaa Sugar Co.	*	G. F. Renton	Ewa
Ewa Plantation Co.	*	G. F. Renton	Ewa
Waianae Co.	***	Fred Meyer	Waianae
Waialua Agricultural Co.	*	W. W. Goodale	Waialua
Kahuku Plantation Co.	x*	Andrew Adams	Kahuku
Waimanalo Sugar Co.	**	G. Chalmers	Waimanalo
Oahu Sugar Co.	x	Aug. Ahrens	Waipahu
Honolulu Plantation Co.	**	J. A. Low	Aiea
Laie Plantation	x*x	S. E. Wooley	Laie
MAUI.			
Olowalu Co.	**	Geo. Gibb	Lahaina
Pioneer Mill Co.	x	L. Barkhausen	Lahaina
Wailuku Sugar Co.	**x	C. B. Wells	Wailuku
Hawaiian Commercial & Sug. Co.	x*	H. P. Baldwin	Puunene
Paia Plantation	x*	D. C. Lindsay	Paia
Haiku Sugar Co.	x*	H. A. Baldwin	Haiku
Hana Plantation	xx	E K. BULL	Hana
Kipahulu Sugar Co.	x	A. Gross	Kipahulu
Kihei Plantation Co.	x*	James Scott	Kihei
Maui Sugar Co.	x**	J. R. Myers	Huelo
HAWAII.			
Paauhau Sugar Plantation Co.	**	Jas. Gibb	Hamakua
Hamakua Mill Co.	*x	A. Lidgate	Paauilo
Kukaiau Plantation	x	J. M. Horner	Kukaiau
Kukaiau Mill Co.	*x	E. Madden	Paauilo
Ookala Sugar Co.	**x	W. G. Walker	Ookala
Laupahoehoe Sugar Co.	*x	C. McLennan	Papaaloa
Hakalau Plantation	**	Geo. Ross	Hakalau
Honomu Sugar Co.	**x	Wm. Pullar	Honomu
Pepeekeo Sugar Co.	*x	H. Deacon	Pepeekeo
Onomea Sugar Co.	**x	J. T. Moir	Hilo
Hilo Sugar Co.	**	J. A. Scott	Hilo
Hawaii Mill Co.	x	W. von Graevemeyer	Hilo
Waiakea Mill Co.	*x	C. C. Kennedy	Hilo
Hawaiian Agricultural Co.	**x	John Sherman	Pahala
Hutchinson Sugar Plantation Co.	**	G. C. Hewitt	Naalehu
Union Mill Co.	*x	Jas. Renton	Kohala
Kohala Sugar Co.	*	E. E. Olding	Kohala
Pacific Sugar Mill	x**	D. Forbes	Kukuihaele
Honokaa Sugar Co.	x**	K. S. Gjerdrum	Honokaa
Kona Sugar Co.	xxx	E. E. Conant	Holualoa
Olaa Sugar Co.	xx*	F. B. McStocker	Olaa
Puna Sugar Co.	xx*	W. H. Campbell	Kapoho
Halawa Plantation	x*x	T. S. Kay	Kohala
Hawi Mill & Plantation	‡‡	John Hind	Kohala
Puako Plantation	‡‡	W. L. Vredenburg	S. Kohala
Niulii Sugar Mill and Plantation	*x	Robt Hall	Kohala
Puakea Plantation	*x	H. R. Bryant	Kohala
KAUAI.			
Kilauea Sugar Plantation Co.	**	A. Moore	Kilauea
Gay & Robinson	x*x	Gay & Robinson	Makaweli
Makee Sugar Co.		G. H. Fairchild	Kealia
Grove Farm Plantation	x	A. H. Smith	Lihue
Lihue Plantation Co.	x	F. Weber	Lihue
Koloa Sugar Co.	x	P. McLane	Koloa
McBryde Sugar Co.	*x	W. Stodart	Eleele
Hawaiian Sugar Co.	x*	B. D. Baldwin	Makaweli
Waimea Sugar Mill Co.	*	J. Fassoth	Waimea
Kekaha Sugar Co.	x	H. P. Faye	Kekaha

KEY.	HONOLULU AGENTS.	
*	Castle & Cooke	(4)
**	W. G. Irwin & Co.	(8)
***	J. M. Dowsett	(1)
x	H. Hackfeld & Co.	(9)
xx	M. S. Grinbaum & Co.	(2)
xxx	McChesney & Sons	(1)
*x	T. H. Davies & Co.	(8)
**x	C. Brewer & Co.	(7)
x*	Alexander & Baldwin	(5)
x**	F. A. Schaefer & Co.	(3)
xx*	B. F. Dillingham & Co.	(2)
x*x	H. Waterhouse & Co.	(3)
‡‡	Hind, Rolph & Co.	(1)

HONOLULU STOCK AND BOND EXCHANGE, JULY 16, 1903.

STOCK	Capital Authorized	Shares Issued	Capital Paid up	Par Value	Last Sale
MERCANTILE					
C. Brewer & Co.	$ 1,000,000	10,000	$ 1,000,000	$ 100	390
L. B. Kerr & Co., Ltd.	200,000	4,000	...	50	
SUGAR					
Ewa Plantation Company	5,000,000	250,000	5,000,000	20	21
Hawaiian Agricultural Co.	1,000,000	10,000	1,000,000	100	245
Hawaiian Com'l & Sugar Co.	10,000,000	100,000	2,312,750	100	45
Hawaiian Sugar Company	2,000,000	100,000	2,000,000	20	24
Honomu Sugar Company	750,000	7,500	750,000	100	105
Honokaa Sugar Company	2,000,000	100,000	2,000,000	20	13¾
Haiku Sugar Company	500,000	5,000	500,000	100	100
Kahuku Plantation Company	500,000	25,000	500,000	20	22
Kihei Plant. Co. Ltd.,	2,500,000	50,000	2,500,000	50	8
Kipahulu Sugar Company	160,000	1,600	160,000	100	....
Koloa Sugar Company	500,000	5,000	500,000	100	164
McBryde Sug. Co. Ltd.	3,500,000	175,000	3,500,000	20	4
Oahu Sugar Co.	3,600,000	36,000	3,600,000	100	102
Onomea Sugar Co	1,000,000	50,000	1,000,000	20	23½
Ookala Sugar Plantation Co.	500,000	25,000	500,000	20	10½
Olaa Sugar Co. Ltd.,	5,000,000	250,000	5,000,000	20	7
Olowalu Company	150,000	1,500	150,000	100	.....
Paauhau Sug. Plantation Co.	5,000,000	100,000	5,000,000	50	12
Pacific Sugar Mill	500,000	5,000	500,000	100	250
Paia Plantation Company	750,000	7,500	750,000	100	.....
Pepeekeo Sugar Company	750,000	7,500	750,000	100	.....
Pioneer Mill Company	2,250,000	22,500	2,250,000	100	100
Waialua Agricultural Co.	4,500,000	45,000	4,500,000	100	47½
Wailuku Sugar Company	700,000	7,000	700,000	100	300
Waimanalo Sugar Company	250,000	250,000	250,000	100	160
MISCELLANEOUS					
Wilder Steamship Company	500,000	5,000	500,000	100	100
Inter-Island Steam Nav. Co.	600,000	6,000	600,000	100	114
Hawaiian Electric Company	500,000	5,000	500,000	100	100
Honolulu R. T. & Land Co.	250,000	2,500	250,000	100	80
Mutual Telephone Company	150,000	13,900	139,000	10	10
Oahu Railway & Land Co	4,000,000	40,000	4,000,000	100	90
Hilo Railroad Co.	1,000,000	50,000	1,000,000	20	.....
BONDS	Amt. of Issue				
Hawaiian Govt. 5 per cent	1,251,200	Dec. 31, 1900	...	...	98
Hilo Railroad Co., 6 per cent	1,000,000	750,000	...	...	100
Hono. R. T. & L. Co, 6 p. c.	300,000	...	...	...	100
Ewa Plantation 6 per cent	500,000	...	...	...	100
Oahu Railway & L'd Co. 6 p. c.	2,000,000	...	...	...	103½
Oahu Plantation 6 per cent	750,000	...	...	...	100
Olaa Plantation 6 per cent	1,250,000	...	...	...	.....
Waialua Agr. 6 per cent	1,000,000	...	...	...	100¼
Kahuku 6 per cent	200,000	...	...	...	101
Pioneer Mill Co., 6 per cent	1,250,000	...	...	...	100